

CRANFIELD UNIVERSITY

FAHAD AL HOSNI

EFFECTS OF R&D IMPLEMENTATION ON THE PERFORMANCE  
OF PUBLICLY FUNDED RESEARCH IN SULTAN QABOOS  
UNIVERSITY

SCHOOL OF MANAGEMENT

PhD THESIS



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Dr. Colin Pilbeam

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## **ABSTRACT**

Models of R&D account for technical, technological and administrative factors of R&D implementation but underestimate the influence of behavioural and political factors such as power and conflict. They assume that R&D organisation is “well-insulated” from partisan, emotions, political reactions and contextual factors and that decision makers are rational and decisions are taken to best fit the content of R&D programme. The present study explores the effects of rational and irrational factors in the R&D implementation process on the performance of publicly funded research projects in universities. It uses realist and qualitative exploratory semi-structured interviews with 22 active researchers in Sultan Qaboos University provides “depth and detail” of the complexities of R&D implementation effects on its performance. The study discovers 18 measures of success of academic research and 30 effects of R&D implementation of the performance of publicly funded research.

The study concludes that the iterative, non-linear and processual nature of R&D implementation is a continuous dynamic system. R&D success builds up the capacity for future success whilst failures decrease the chances of future successes. The integrated effects of implementation (IEI) influence R&D performance through technical and administrative capability of the R&D organisation as well as through behaviours of organisation members. These include leaders’ behaviours, conflict and political skills within individuals. Both success dynamism and IEI suggest contextualism implementation of R&D.

Keywords:

R&D success, performance measurement, university research, leadership, organisational behaviour, Higher Education.



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## TABLE OF CONTENTS

1	INTRODUCTION.....	1
1.1	INTRODUCTION.....	1
1.2	BACKGROUND.....	1
1.3	RATIONALE.....	3
1.4	AIM OF THE RESEARACH.....	5
1.5	THEORETICAL FRAMEWORK.....	5
1.6	METHODOLOGY OVERVIEW.....	6
1.7	THESIS STRUCTURE.....	7
1.8	RESEARCH CONTRIBUTIONS.....	9
1.8.1	Contribution to theory.....	9
1.8.2	Contribution to practice.....	9
1.9	SUMMARY.....	10
2	POSITIONING THE STUDY.....	11
2.1	INTRODUCTION.....	11
2.2	ACADEMIC SCIENCE.....	11
2.2.1	Classical norms of academic science.....	12
2.2.2	Societal view of academic science.....	13
2.3	IMPORTANCE OF SCIENCE FOR ECONOMIC GROWTH.....	15
2.3.1	The linear flow model.....	15
2.3.2	The Triple Helix model.....	17
2.4	CHANGES IN HIGHER EDUCATION SYSTEMS.....	19
2.4.1	Policy-level changes.....	20
2.4.2	Changes at institutional level.....	21
2.4.3	Strategic changes.....	21

---

2.5	SULTAN QABOOS UNIVERSITY .....	27
2.5.1	Oman .....	28
2.5.2	Sultan Qaboos University .....	28
2.5.3	Colleges of SQU.....	31
2.6	RATIONALE .....	34
2.6.1	Management of R&D in business .....	35
2.7	SUMMARY .....	40
3	LITERATURE REVIEW.....	41
3.1	INTRODUCTION.....	41
3.2	OPENING REMARKS .....	41
3.3	SUCCESS MEASURES .....	43
3.4	ATTRIBUTES OF R&D SUCCESS .....	45
3.4.1	R&D strategy .....	60
3.4.2	Organization .....	62
3.4.3	Team .....	65
3.4.4	Task or project.....	67
3.5	MODELS OF R&D IMPLEMENTATION .....	69
3.5.1	Linear models.....	70
3.5.2	Non-linear approaches .....	73
3.6	APPROACHES TO IMPLEMENTATION STRATEGIES .....	76
3.6.1	The classical approach.....	76
3.6.2	The contingency approach .....	78
3.6.3	The behavioural approach.....	79
3.6.4	The political approach .....	80
3.7	CONCEPTUAL FRAMEWORK .....	82
3.8	SUMMARY .....	85

---

4	METHODOLOGY .....	87
4.1	INTRODUCTION .....	87
4.1.1	Research question .....	88
4.1.2	Purpose of the research .....	88
4.2	RESEARCH PARADIGMS .....	89
4.2.1	Overview of research paradigms .....	90
4.2.2	Selection of research paradigm for this study .....	92
4.2.3	Summary of the section .....	96
4.3	RESEARCH STRATEGY AND RESEARCH METHODOLOGY ..	100
4.3.1	Research strategy .....	100
4.3.2	Research methodology .....	102
4.4	RESEARCH DESIGN .....	107
4.4.1	Data collection .....	107
4.4.2	Sampling methods .....	109
4.4.3	Interviewees .....	111
4.4.4	Conduct of interviews .....	113
4.4.5	Data analysis .....	114
4.4.6	Summary of the section .....	118
4.5	RESEARCH QUALITY .....	119
4.5.1	Consistency .....	120
4.5.2	Internal validity .....	123
4.5.3	Generalisation .....	124
4.5.4	Summary of the section .....	125
4.6	CHAPTER SUMMARY .....	125
5	FINDINGS: SUCCESS MEASURES .....	127
5.1	INTRODUCTION .....	127

---

5.2	PRESENTATION OF THE FINDINGS .....	127
5.3	FINDINGS FROM THEMATIC ANALYSIS .....	129
5.3.1	Emergent themes: categories of measures .....	132
5.3.2	Category one: standard measures of project success.....	133
5.3.3	Category two: knowledge production .....	137
5.3.4	Category three: educational contributions .....	141
5.3.5	Category four: capacity building .....	145
5.3.6	Category five: institutional economic benefits.....	151
5.3.7	Category six: policy benefits.....	156
5.3.8	Category seven: broader social benefits .....	159
5.4	DISTRIBUTION ANALYSIS.....	164
5.4.1	Distribution of extracts and measures on interviewees based on their nature of science .....	164
5.4.2	Distribution of extracts and measures on interviewees based on academic post .....	165
5.4.3	Distribution of extracts and measures on interviewees based on their administration Experience .....	166
5.4.4	Conclusion.....	166
5.5	CHAPTER SUMMARY .....	166
6	FINDINGS: IMPLEMENTATION EFFECTS .....	169
6.1	INTRODUCTION.....	169
6.2	PRESENTATION OF THE FINDINGS .....	169
6.3	FINDINGS FROM THEMATIC ANALYSIS .....	171
6.3.1	Category one: strategy related effects.....	175
6.3.2	Category two: task/project related effects .....	184
6.3.3	Category three: team related effects .....	196
6.3.4	Category four: organisational effects.....	210

---

6.3.5	Category Five: behavioural effects .....	228
6.4	DISTRIBUTION ANALYSIS.....	239
6.4.1	Distribution of extracts and effects on Interviewees based on science classification of the interviewees .....	239
6.4.2	Distribution of extracts and effects on interviewees based on their rank .....	240
6.4.3	Distribution of extracts and effects on interviewees based on their administration experience.....	241
6.4.4	Conclusion.....	241
6.5	CHAPTER SUMMARY .....	241
7	DISCUSSION.....	245
7.1	INTRODUCTION.....	245
7.2	SUCCESS OF ACADEMIC RESEARCH .....	247
7.2.1	R&D Output.....	247
7.2.2	Impacts of R&D .....	249
7.2.3	Dynamism of R&D success .....	251
7.2.4	Conclusions and propositions.....	253
7.3	EFFECT OF IMPLEMENTATION ON R&D PERFORMANCE ....	255
7.3.1	Effects of R&D strategy .....	255
7.3.2	Effects of R&D task/project.....	257
7.3.3	Effects of R&D team .....	259
7.3.4	Effects of the R&D organisation .....	260
7.3.5	Effects of human behaviours on R&D performance .....	262
7.3.6	Contextualism of implementation effects.....	270
7.3.7	Conclusions and propositions.....	273
7.4	CHAPTER SUMMARY .....	276
8	CONCLUSIONS.....	277

---

8.1	INTRODUCTION.....	277
8.2	SUMMARY OF KEY FINDINGS.....	277
8.2.1	Dynamic success of R&D.....	278
8.2.2	Integrated effect of implementation.....	279
8.3	CONTRIBUTIONS OF THE STUDY.....	280
8.3.1	Contributions to theory.....	280
8.3.2	Contributions to methodology.....	283
8.3.3	Contributions to practice.....	284
8.4	RESEARCH LIMITATIONS.....	285
8.4.1	Researcher’s bias.....	285
8.4.2	Context based limitation.....	286
8.4.3	Recommendation for future research.....	286
8.5	CHAPTER SUMMARY.....	287
	REFERENCES.....	289
	APPENDICES.....	315

---

## LIST OF FIGURES

Figure 1.1:	Flow of the study and the organisation of the thesis	8
Figure 2.1:	Innovation process as viewed by Francis Bacon (Kealey, 1996)	16
Figure 2.2:	Innovation process as viewed by Adam Smith (Kealey, 1996)	17
Figure 2.3:	The “Triple Helix” of innovation system	19
Figure 2.4:	Developments in industrial and academic research as perceived from the literature.	39
Figure 3.1:	Linguistic platform for the present study, by the author.	42
Figure 3.2:	Cooper’s Stage-Gate model for NPD process, (Cooper, 2001)	71
Figure 3.3:	The development funnel model for R&D and innovation projects, (Hauser et al., 2006).	72
Figure 3.4:	Spiral model for innovation management, Source Boehm (1988) with modification.	73
Figure 3.5:	The chain-linked model of innovation. Link I supplies instruments from manufacturing sector to scientific research. Link S supports fundamental research in industry. Link C is a two-way flow of ideas between scientific research and synthetic design. Links K and R link knowledge and research utilized in innovations. (Kline, 1990).	74
Figure 3.6:	Implementation of university research viewed as a 3 dimensional visualisation of the strategy implementation literature, by the author.	84
Figure 4.1:	Layout for presentation of the findings.	118
Figure 5.1:	Number of emerged new measures from interviews	128
Figure 6.1:	Numbers of effects as they emerged from the interviews	170
Figure 7.1:	Implementation effects integration (IEI) and their influence on the performance of R&D project.	246
Figure 7.2	Dynamic success of academic R&D	254
Figure 7.3:	Integrated effects of implementation on R&D performance	273

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## LIST OF TABLES

Table 2.1:	Summary of classical and societal views of science, source Ernø-Kjølhede et al., (2000) with modification. ....	14
Table 2.2:	Distinctions between research Mode-1 and Mode-2 (Arnold and Balázs, 1998, with modifications).....	22
Table 2.3:	Summary of the differences between IG and SR research in SQU. ....	32
Table 2.4	Differences and similarities: SQU, UK universities and companies.....	35
Table 2.5:	Basic characteristics of different generations of R&D management, source Liyanage et al., (1999). ....	38
Table 3.1:	List of factors compiled from the literature review of R&D and innovation fields. R&D refers to research and development, NPD refers to new product development, NSD means new service development MTA is manufacturing technology acquisition and ITA refers to information technology acquisition.....	59
Table 4.1:	Definition of research concepts, adapted from Easterby-Smith, et al. (2002).....	89
Table 4.2:	Philosophical perspectives of inquiry and implications for management research. Adapted from Blaikie (1993), Johnson and Duberley (2000) and Easterby-Smith et al. (2002). ....	99
Table 4.3:	List of interviewee. AS: Applied Science, SS: Social Science, BS: Basic Science, FP: Full Professor, MP: Associate Professor, AS: Assistant Professor, AE: Administration Experience and LAE: Lacking Administration Experience. ....	112
Table 4.4:	Perspectives on research quality in different philosophical stances, (Easterby-Smith et al., 2002) .....	120
Table 4.5:	Results of the inter-rater consistency tests. ....	122
Table 5.1:	List of the 18 success measures as found empirically. Columns in light colours show interviewees from Social Sciences while dark ones represent interviewees from Basic Sciences. Clear columns show Applied Sciences. ....	131



---

Table 5.2:	Comparison between categories of success measures found by the study in hand and that of HERG's payback model.....	132
Table 5.3:	Distribution of extracts in the category "Standard measures of project success" based on different interview groups.....	133
Table 5.4:	Distribution of extracts in the category "Knowledge production" based on different interview groups. ....	137
Table 5.5:	Distribution of extracts in the category "Informing teaching" based on different interview groups. ....	142
Table 5.6:	Distribution of extracts in the category "Capacity building" based on different interview groups. ....	146
Table 5.7	Distribution of extracts in the category "Institutional economic benefits" based on different interview groups.....	152
Table 5.8:	Distribution of extracts in the category "Policy benefits" based on different interview groups. ....	157
Table 5.9:	Distribution of extracts in the category "Broader social benefits" based on different research groups.....	160
Table 5.10:	Distribution of extracts based on their College. ....	165
Table 5.11:	Distribution of extracts based on academic post. ....	165
Table 5.12:	Distribution of extracts based on Administration Experience...	166
Table 6.1:	List of the 30 implementation effects found empirically. Columns in light colours show interviewees from social science disciplines while dark ones represent interviewees from basic science disciplines. Clear columns show applied science disciplines. .	174
Table 6.2:	Contribution of different research groups to the identification of the category "Strategy related effects". ....	175
Table 6.3:	Contribution of different research groups to the category "Task/Project related effects". ....	185
Table 6.4:	Contribution of different groups to the category "Team related effects". ....	196
Table 6.5:	Contribution of different research groups to the category "Organisational effects". ....	210
Table 6.6:	Contribution of different research groups to the category "Behavioural effects". ....	228

---

Table 6.7:	Distribution of extracts on based on their nature of interviewees' science classification.....	240
Table 6.8:	Distribution of extracts on interviewees based on their rank. ..	240
Table 6.9:	Distribution of extracts from interviewees based on their Administration Experiences.....	241

# **1 INTRODUCTION**

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## **1.1 INTRODUCTION**

This thesis is an exploratory piece of work set in the Higher Education sector. The emphasis is on management of research. The main reason for selecting this topic is the involvement of the researcher in research administration in Sultan Qaboos University (SQU) in Oman.

This chapter introduces the rationale of how to go about the study in hand. The aim of the research and the outline and structure of the thesis are presented. Later the proposed contributions of this study to educational research and theory are introduced and the chapter is summarised.

## **1.2 BACKGROUND**

This study considers the measurement of the success of publicly funded academic research and the possible effects of R&D implementation on these measures. Research refers to creative work undertaken on a systematic basis in order to increase the stock of knowledge, including knowledge of human, culture and society (OECD, 2008). Researchers in non-academic environments extend their efforts beyond the discovery or invention stage and enter into the development stage. Development is the use of the stock of knowledge to devise new applications (OECD, 2008). In the past academic research tended to stop at this stage (discovery or invention and publication) and the researchers received an academic reward such as a higher degree, but increasingly academic research is being transformed, with a greater role on development through the process discussed in chapter two of this thesis.

At national level, the impact and significance of academic research for economic developments was recognised as early as the seventeenth century

(Kealey, 1996). However, formal institutionalised forms to use science for economic developments occurred only after the Second World War (see chapter two). Since then the linear flow model of innovation process has been dominant, in which industry, government and universities were working in separate spheres. In the 1980s and after, several interrelated structural and societal changes have accompanied the increasing public and industrial questioning of scientific norms. This has resulted in an emergence of new societal view of scientific knowledge and new model for knowledge production, the “Triple Helix” (Etzkowitz, 1989). The “Triple Helix” model views industry as producer, university as creator of new knowledge and technology, and government as medium for regulating and organizing the relationship between all three parties. The new societal view of academic knowledge has introduced a third mission to universities (Etzkowitz, 1998), and in turn has introduced them to a significant level of accountability. As a result of these developments, the intellectual curiosity in universities has become a less dominant driver for academic research (Connell, 2004).

The academic freedom that allowed academics to work to satisfy their intellectual curiosity without being questioned is being increasingly challenged. Governments have started to adopt policies to ensure value for money for research investment. Overall public research budgets have been severely challenged. Strict requirements were imposed on universities to collaborate with industry and other societal parties in light of the “Triple Helix” (Faulkner and Senker, 1995). In addition, the new utilitarian view of scientific knowledge posed a new quality criterion in which traditional academic evaluation is claimed not sufficient (Kutinlahte, 2005). The Government introduced the Research Assessment Exercises (RAE) at both institutional and research programme levels (Geuna, 1997; Geuna and Martin, 2003; Kleeman, 2003). Universities and other public research institutions became more conscious of their research and strove to satisfy the national research requirements in order to justify (and retain or gain) public funding.

Universities are now changing in terms of nature of their research, from a disciplinary to interdisciplinary context (Gibbons et al., 1994). A “**market-like**” behaviour is witnessed in universities (Slaughter and Leslie, 1997; Pilbeam 2008) to secure other forms and sources of funding because of the decline in public support. A notion of “Entrepreneurial University” has emerged (Etzkowitz, 1989 and 2000; Clark, 1998; Etzkowitz, Healey and Webster, 1998; Pilbeam, 2008). As a result governance systems are also transforming from collegiate to managerial (Connell, 2004; Middlehurst, 2004; Hazelkorn, 2005).

This thesis considers management of research in universities in the light of the above transformation. The emphasis is on the effects of R&D implementation in lights of this transformation on the success of R&D. Thus it is important to investigate how success is being defined in the academic environment. The study is hosted in Sultan Qaboos University (SQU) in Oman, see Section 2.5 for detailed description. SQU, like other universities, aims to satisfy national requirements of research performance (Geuna and Martin, 2003). SQU has a clear mission statement to serve the Omani needs.

### **1.3 RATIONALE**

Universities responses, in light of the above transition, have been directed to justify public funding for research (Geuna and Martin, 2003). This makes academic research, in a way, similar to R&D activities that are conducted in business organisations. Although universities are institutional organisations, they operate in market place (Pilbeam, 2008) where they respond to their shareholders just like private R&D. Further, both R&D activities (academic and private) are conducted by highly qualified personnel. The research activity itself is similarly carried out using a scientific method. This suggests that academic research may benefit from strategies for managing R&D similar to those found in the business environment.

Private R&D was driven by intellectual curiosity, just like academic research, until about the mid 1950s. In late 1950s to 1960s, business adopted basic

principles of project management in what is now called the first generation of R&D management. R&D was science push type therefore it lacked strategic directions and it was considered an overhead cost (Roussel, 1991). In the 1970s and 1980s private R&D efforts were aligned with market-driven objectives and strategies with emphasis on knowledge generation. This concept is regarded now as the second generation of R&D.

In the late 1990s, a third generation of R&D management emerged (Roussel, 1991). Corporate and R&D strategies were linked, and the R&D function was considered accountable for its efficiency and effectiveness. Consequently R&D units started to use of a common language with other units. The fundamental, incremental and radical research terms replaced basic and applied research which optimised the communication processes between researchers and corporate managers. This, in turn, integrated the strategic and operational functions with a main focus on R&D's contribution to the competitive advantage of the organization.

In the early 1990s, the emergence of fourth generation of R&D management has been claimed (Liyanage, 1999). Its character consisted of endogenous R&D management which dealt with investment and resources management and exogenous R&D management which dealt with knowledge management in joint ventures, strategic alliances and research links and collaboration. Rothwell (1994) claimed this as a fifth generation in the innovation process because he separated the first generation here into two; the first with rapid economic growth and the second with steady economic growth.

The third and fourth generations of private R&D management could be of importance to academic research. These generations used success factors to develop techniques such as project portfolio management, Stage-Gate (Cooper, 2001), and the Funnel model for innovation projects (Goffin and Mitchell, 2005). It is argued here that study of these techniques and models may be beneficial to academic research despite the differences with commercial and industrial. Further, there is a need to find out how firms came to conclude the need to use such techniques.

## **1.4 AIM OF THE RESEARCH**

The study in hand is set against the background of changing modes of operation in the higher education sector and the consequent demands for effective management of research projects in universities. The aim is to provide guidelines to enhance the management of university research at individual project level. The objective of this study is to explore what factors influence the success of academic research and how these factors are inter-related to each other in order to provide guidance for successful research projects.

***How does R&D implementation influence the performance of publicly funded research in SQU?***

The following sub-questions could be of help to answer the main one:

- What constitutes success for publicly funded academic research?
- What components of R&D implementation influence the performance of research in SQU?
- How do these components integrate (or not) to influence the performance of research in SQU?

## **1.5 THEORETICAL FRAMEWORK**

Studies of the success of R&D lack a single universal model, rather the impact of implementation is context-based (Balachandra and Friar, 1997). R&D models approach implementation with rationalist view. They account for technical, technological and administrative factors in R&D implementation but underestimate the influence of behavioural and political factors such as politics and conflict. It is generally assumed that a R&D organisation is “well-insulated” from partisan, emotions and political reactions, decision makers are rational and decisions are taken to best fit the content of R&D programme and contextual factors. The irrational, creative and intuitive influences of the human side are

usually ignored and the potential threat of misunderstandings and conflict (contextualism) underestimated.

The present study explores the effects of rational and irrational factors in R&D implementation on the performance of research projects. The findings of Pilbeam (2002), Goffin and Mitchell, (2005) and Ottenbacher et al., (2006) may support the belief that beside the effects of rational factors there are others of irrational factors. Pilbeam (2002) found some factors such as “Degree of interestingness” and “Degree of fun the team find in the project”. These may suggest behavioural influence on the performance of the research project. He also found “Imposed idea” of influence which may suggest political influence on R&D implementation. Ottenbacher et al., (2006) found that “Involvement of employee” significantly influenced the degree of success of New Service Development (NSD). This may be interlinked with the feelings of the staff members towards ownership of the new service.

### **1.6 METHODOLOGY OVERVIEW**

This exploratory study attempts to gain a deeper understanding of implementation effects on the performance of academic research. Realist ontological and relativist epistemological assumptions of this research justified qualitative, interpretive research. The qualitative approach is in line with the nature of the phenomenon and the research question being investigated. The influence of implementation on R&D performance in universities is a complex and a contemporary phenomenon. It requires exploration of a process in its context and theory building. Qualitative methodology provides “depth and detail” of the complexities of the research phenomenon through mapping the contextual nature of academic research. This methodology could help discover generative structures and put forward new propositions/concepts about relationships of implementation factors in university R&D in light of the new social view of science (Patton, 1990).



Inductive/retroductive research strategy fits with the philosophical assumptions and a grounded data analysis approach which was used to develop ideas and constructs as they flow from the research data whilst prior theoretical models and hypotheses are used to explain observations from the social world (Perry et al., 1998).

## **1.7 THESIS STRUCTURE**

Chapter two sets the scenes for the study. It highlights the changes which the university has been subjected to lately. It also positions the study of the management academic research in the context of management of private R&D and overlapping fields. The argument here was that there are similarities and each can benefit from the other. Chapter three reviews the literature on effects of implementation on R&D performance and success, measured at R&D project level. It identifies payback model from the evaluation of HNS research (see Section 3.3) and a list of 221 effects of implementation on R&D performance.

Chapter four discussed the methodology chosen for this study. It discussed different paradigms and why a realism paradigm was chosen. It presents the design of this research and reports the actual implementation of the chosen method. It highlights the practical steps taken and what actually happened.

Chapters five and six present the data analysis and the findings of the study. Chapter five discusses the findings related to measures of success of publicly funded academic research whilst chapter six presents the results of implementation effects on performance of publicly funded academic research. Further it classifies different success measures and effects in different categories as were thought relevant.

Chapter seven discusses the results of this study and links them to the existing body of the literature. Chapter eight concludes the study with the contributions to knowledge made by this study. It also presents the limitations of the study and some recommendation for future research. Figure 1.1 provides a layout of the thesis as well as the flow of the study.

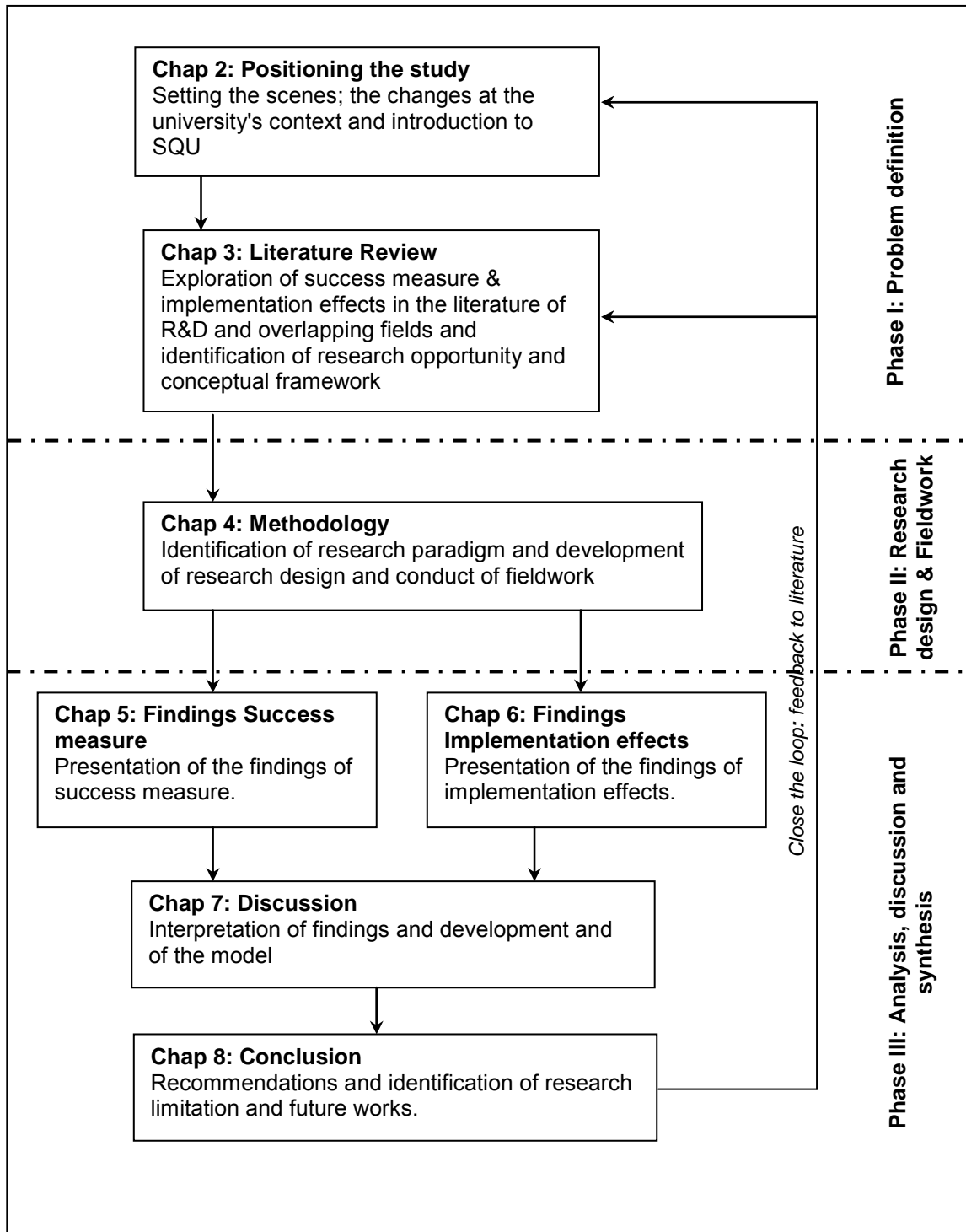


Figure 1.1: Flow of the study and the organisation of the thesis

## **1.8 RESEARCH CONTRIBUTIONS**

### **1.8.1 Contribution to theory**

The theoretical contributions of this research to the body of knowledge enhance our understanding of what R&D success is, in light of the emergent social view of science, and the effects of implementation on R&D performance. By providing empirical evidence of integrated effect of implementation on R&D performance, this study also makes a number of more specific contributions to the literature of R&D. These contributions to academic knowledge broadly include:

- Introduction of rational and irrational (contextual) effects to the implementation of R&D.
- Confirming the importance of contextual limits in considering R&D success.
- Introduction of dynamism in the success of R&D.
- Presenting a holistic picture of R&D implementation that integrates different effects on performance identified in the literature.
- Support the literature of organisational change on the contextualist nature of organisational change.

### **1.8.2 Contribution to practice**

This research provides a valuable contribution to the practice of R&D management. It draws attention to the behavioural dimension in R&D implementation. This research demonstrates that an understanding of internal conflicts and how these conflicts are managed are essential skills for the research team. Thus, in practice it is vital that R&D teams are fully equipped with the necessary skills to fully carry out their duties which include the management of organisational and personal conflict.

Another element of value to R&D practice is the need to establish an effective leadership in R&D organisation. This study pinpoints the main area for continued success. Knowledge is a source for other outcomes and impact successes of R&D but the model shows that R&D capacity is the success measure that enables other future successes. R&D managers need to build this into their management approach and R&D performance systems. R&D leaders need to keep an eye on the complexity of their R&D contextual circumstances knowing that current successes do not ensure future ones.

### **1.9 SUMMARY**

This chapter has introduced the reader to the thesis in hand. It has provided an overview of the motives of the study and the contextual background of the topic under investigation. Changes to higher education institutions have caused an emergence of a third mission and “market-like” behaviour. These changes could be compared to those that R&D in business environment witnessed from the 1950s till now. With such a rationale the chapter highlighted the objective of this study and research questions. Thesis outline and structure were then presented. The chapter concluded with the contributions of the study.

## 2 POSITIONING THE STUDY

---

### 2.1 INTRODUCTION

This chapter sets the scenes for this study. It provides an overview of why it has become necessary for universities to manage research activities and optimise their efficiency and effectiveness. Then the classical norms of science and the emergent social contract of scientific knowledge are discussed. These include the importance of knowledge for economic growth. The chapter then draws on worldwide political interventions to harness economic benefits from academic knowledge. The consequent changes in the university system are then highlighted. Following these discussions, the position of Sultan Qaboos University (SQU) is presented as a hosting cite for the present study.

Because of similarities the chapter compares the developments in the industrial R&D and technology and innovation projects to the changes that academic research has witnessed recently. It introduces the argument that university research may benefit from the developments in management of private R&D and innovation projects. Finally the chapter indicates the way forward for this thesis.

### 2.2 ACADEMIC SCIENCE

The role of the classical university was solely creating and passing knowledge to students via teaching. The first university evolution was in 1810 made some changes following the recommendations of Von Humboldt (Etzkowitz, 1989). Humboldt emphasized that research is a responsibility of all academics in order to inform the teaching process. Universities, however, take different approaches to allocation of the responsibilities for teaching and research to individual staff. For example, not all academics participate in both teaching and research, at least to the same degree, and different balances exist (Connell, 2004).

Universities, increasingly, facilitate teaching-free periods for active academics in research. They create new prestigious categories of academic appointments primarily focused on research performance. This questions Von Humboldt's concept that academics should conduct research to inform teaching. This question is, however, beyond this study.

### 2.2.1 Classical norms of academic science

In the 1950s, Robert Merton introduced four norms of science; *Universalism* (work is evaluated based on universal or impersonal criteria), *Skepticism* (ideas must be tested), *Communalism* (knowledge is exchanged for recognition and esteem) and *Disinterestedness* (scientist are rewarded for acting selflessly) (Merton, 1973). The idea behind these norms was that science is distinct in comparison to other forms of knowledge where external political or cultural interference could compromise the necessary moral conditions required to make it possible for certified knowledge to exist. The academic ethos brought by Merton is a significant part of a broader ideology of good science (Gieryn 1982).

Merton's work proposed science as an activity that depends on academics being open-minded, impartial and self critical (Kutinlahte, 2005). Thus, scientific knowledge is socially neutral under the assumption that it is the implicit motive for academics. It forms the basis for rewards in the academic environment. However, real social practice contradicts the notion of truly objective and disinterested truth seeking (Ziman, 1996; Calvert, 2002).

Merton rejected the examination of scientific work by any others than the scientific community itself. This emphasised an ultimate cognitive authority to academic research. The rules of norm, however, are defined by those who live and act in the everyday world. Because they are only translated into behavioural patterns once collective decisions have been made in a given setting (Cicourel, 1974). This view suggests the rules of scientific conduct are

subject to continuous negotiation where non-accepted behaviour today may become acceptable tomorrow (Kutinlahte, 2005).

The Merton model induced university autonomy and academic freedom and as a result a legitimate position for universities and an internal operation mode were created (Middlehurst, 2004). In legitimate terms, university autonomy and academic freedom were essential pre-conditions for the disinterestedness of scientific knowledge. Collegial governance supported this legitimate position. Academics' authority in decision-making processes was present through committee structures. Committees integrated ranges of disciplines and academic interests to achieve consensus about the direction and functioning of the institution. The committee's role was further enhanced by a turnover and overlapping membership of administrative responsibilities for academics (Connell, 2004).

Committees in universities, commonly have responsibilities related to aspects of research; such committees include "research advisory boards" and "research committees". Today, they are important elements of stakeholder involvement in decision-making throughout the institution. This, however, was an idealistic visualisation of institutional governance because it frequently deteriorated into "academic selfishness" in which the threats of the latest developments (see Section 2.2.2) may appear risky (Middlehurst, 1992).

### **2.2.2 Societal view of academic science**

In the 1990s, a complex framework for policy discussions viewed academic science as a resource for the growth of a knowledge-based economy. The focus was on public research being part of a national R&D investment (Häyrynen-Alestalo and Kallerud, 2004). It concluded a need for an integrated investment structure for public research and the developments of other public concerns such as health, social cohesion and sustainable developments.

The emerged view of science contradicted the classical view (Ernø-Kjølhede et al., 2000). The classical view sees knowledge as a goal in itself while the social

view sees the goal in the application of the acquired knowledge (utilitarian view). Academic research, in the societal view, should take an active part in addressing national needs (Table 2.1). It requires not only accountability and post evaluation but also some upfront consideration of social needs during the process of resource allocation (Cozzens et al., 1994; MacLean et al., 1998).

	<b>Classical view of science</b>	<b>Societal view of science</b>
Purpose of science	Knowledge as an end in itself	Application of knowledge
Quality evaluated by	Intra-scientific criteria	Intra- and extra-scientific criteria
Researcher	Independent and autonomous	Manageable, according to organizational objectives.
Source of control	Peers	Organization management approach
Best science development takes place through	Self-organization	Institutional and political management
Image of research	Research is unpredictable therefore unmanageable	Research is purposive and intentional and manageable: as researchers have standard research methodologies
Image of researcher	Individualist, self-motivating, free thinker with personal research agenda	Individualist and team player. Researcher is an employee who needs motivation, must integrate his research agenda with organizational one, free and institutional thinking

Table 2.1: Summary of classical and societal views of science, source Ernø-Kjølhede et al., (2000) with modification.

Unlike previously, universities became explicitly accountable for the money they received (Geuna, 1997; Geuna and Martin, 2003) and as a result higher priority was given to user involvement (Pavitt, 2001; Goldfarb and Henrekson, 2003). At the resource allocation stage, scientists and universities are called to address the needs of users in return for public funds. In the societal view of science, post evaluation assumes that the knowledge generated from academic research is not reliable until validated socially (Nowotny, 2001). This is to say, academic knowledge is neither self-sufficient nor self-referential, although the



basic conditions and processes behind its production are not, necessarily, compromised.

The utilitarian views the university's knowledge roots through social responsibility theory (Bok, 1993; Geiger, 1993). The concept is that non-profit organisations, such as universities, are established to serve their clients; students, government, and the public interest at large. The indirect benefits resulting from training and from unplanned discoveries may be economically more considerable than the benefits resulting from formal networking and commercialisation. This view provided a general account for the practical use of academic knowledge and as a result a third mission was introduced to universities. This mission could take place in the forms of industrial and societal contribution, collaboration and commercialisation of research (Etzkowitz 1989; Gibbons et al., 1994; Geuna, 1997; Etzkowitz et al., 2004; Slaughter et al., 2004; Pilbeam, 2006).

## **2.3 IMPORTANCE OF SCIENCE FOR ECONOMIC GROWTH**

The importance of new knowledge for socio-economic developments had been widely recognised as early as the seventeenth century. Francis Bacon (1561-1626) was the first to propose an economic justification as to why society should fund learning and scientific research (Kealey, 1996). However, policy interventions to harness science for utilitarian purposes took more institutionalised forms only after the Second World War (Kutinlahte, 2005). These developments are discussed in the following sub-sections.

### **2.3.1 The linear flow model**

After the World War II scientists such as Bush (1947, reprinted 1980) realised that knowledge was, in itself, a power. Bush (1947, reprinted 1980) built on Bacon's work and developed a science-push model for knowledge production, now called the "linear flow" model (Figure 2.1). This model justified public funding for academic research, by promising to create knowledge on which

firms and industry could build in an overall innovation process. This process was claimed to enable achievements of social and political goals such as creating new jobs. In doing so, it supported Merton's academic freedom. Both models allowed academics to work to satisfy their intellectual rigour without being questioned and the process was left to manage itself (Kutinlahte, 2005).



Figure 2.1: Innovation process as viewed by Francis Bacon (Kealey, 1996)

In the same period, the concept *market failure* (demand-pull) was introduced by Richard Nelson and Kenneth Arrow (Kutinlahte, 2005). This concept describes the situation in which markets do not efficiently allocate goods and services. It assumes that a social optimum can be gained by pure market relationships and governments should, only re-address these demands. It also views academic knowledge as a public domain property which should be accessible to all at all times. Free accessibility to academic knowledge it was claimed enabled industry to solve practical problems and promote the advancement of technology (Nelson, 2006). Such claims supported the linear flow model but resulted in under investment in academic research from private sector (Kutinlahte, 2005).

After the Second World War, political interventions to utilise science for socio-economic developments started to take shape. In the UK for example the first intervention took place in mid 1960s. Special Higher Education institutions (different from classical universities) were created to respond directly to social and industrial needs, these were later known as "Polytechnics". This political intervention was considered a significant step towards socio-economic goals (Middlehurst, 2004). The second policy intervention was in the mid-1980s through the introduction of a social market for Higher Education. Consumer's (students) choices were assumed to be free from state controls and/or teachers. Therefore, this market would create competition between institutions which

should drive standards up. This intervention included the creation of trilateral linkages between student choice, demand for Higher Education and the socio-economic requirements (Middlehurst, 2004). In the late 1980s, another political intervention introduced externally assessed quality assurance to the Higher Education sector (Pavitt, 2001) for both teaching through the Higher Education Funding Councils and research through the Research Assessment Exercises (RAE).

Until this, policy interventions were based on the Merton model of science and the linear flow of knowledge production. In the early 1990s, policy makers noticed that the Higher Education institutions were autonomous and self-governing. This meant that bureaucratic, financial or legislative mechanisms alone could change their practices and behaviour. A need, therefore, arose to re-address the core functions of universities in the view of wider socio-economic goals. With the introduction of the new social contract of science (Section, 2.2.2), some researchers rather than studying policy intervention, challenged the linear flow model itself (Kutinlahte, 2005). Many of these works were based on the theory that Adam Smith developed and published in his book “The wealth of nations” in 1776. Smith agreed with Bacon that science is important for wealth creation (Kealey, 1996) but disagreed on the linearity of the flow of innovation process (Figure 2.2). The developments of this challenge are discussed in the following sub-section.

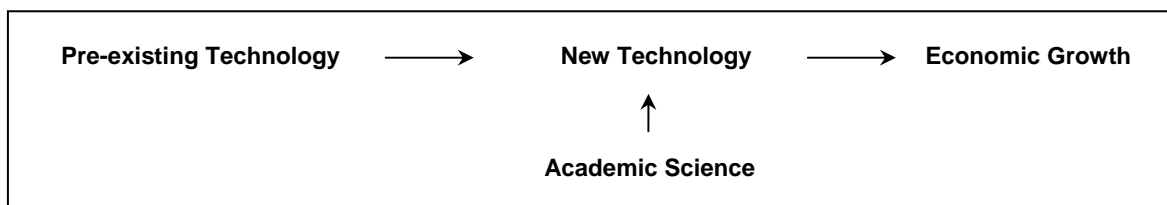


Figure 2.2: Innovation process as viewed by Adam Smith (Kealey, 1996)

### **2.3.2 The Triple Helix model**

With the rise of the knowledge-based economy, knowledge became essential for technological development, consensus became important to get the relevant

actors to work together; and innovation became a target to enhance growth processes (Etzkowitz, 1989; Etzkowitz et al., 1998 and 2004). Three institutions hosted these components; universities, governments and industry. The relationship between the three institutions turned into a “Triple Helix” relationship (Figure 2.3) (Etzkowitz et al., 1998 and 2004). In this model, the university is creator of knowledge and technology, industry/business is producer, and government is a regulating and organising medium. Basic and applied sciences and technology are interrelated activities and innovation starts in any one of the three helices (Etzkowitz et al., 2004). Research takes a multidisciplinary and commercial character, being undertaken in a variety of places and with different external partners (from other universities, government research laboratories or researchers in private industry).

Academic research sometimes leads industrial technology but also sometimes breeds it (Mansfield, 1991; Rosenberg and Nelson, 1994; Cohen et al., 2002). In the USA, for example, 11% of new products and/or process innovations introduced between 1975 and 1985 benefited from academic science (Mansfield, 1991). Research conducted in universities stimulated and enhanced industrial R&D rather than providing a substitute for it (Rosenberg and Nelson, 1994). Academic research played a more important role for completion compared to initiation of industrial R&D projects (Cohen et al., 2002). It provides technological guidance on a project’s progression and completion as opposed to the linear flow of knowledge model.

Each helix went through an internal transformation, for example universities assumed a socio-economic mission, firms developed strategic alliances and governments revised rules of intellectual property to transfer ownership from individuals to universities (Etzkowitz, 1989). Industrial policies focused upon improving government–business relationship by new initiatives. The interaction between the university and industry took different forms such as research contracts, collaborative research projects or joint venture companies. Governments also started to adopt several policies to ensure value for money for research funds. For example, overall public research budgets were severely

challenged and strict requirement were imposed on universities to collaborate with industry and other societal parties (Etzkowitz, 1989; Gibbons et al., 1994; Geuna, 1997; Etzkowitz et al., 1998 and 2000; Clark 1998; Geuna and Martin, 2003; Pilbeam, 2008). These changes are elaborated in the next section.

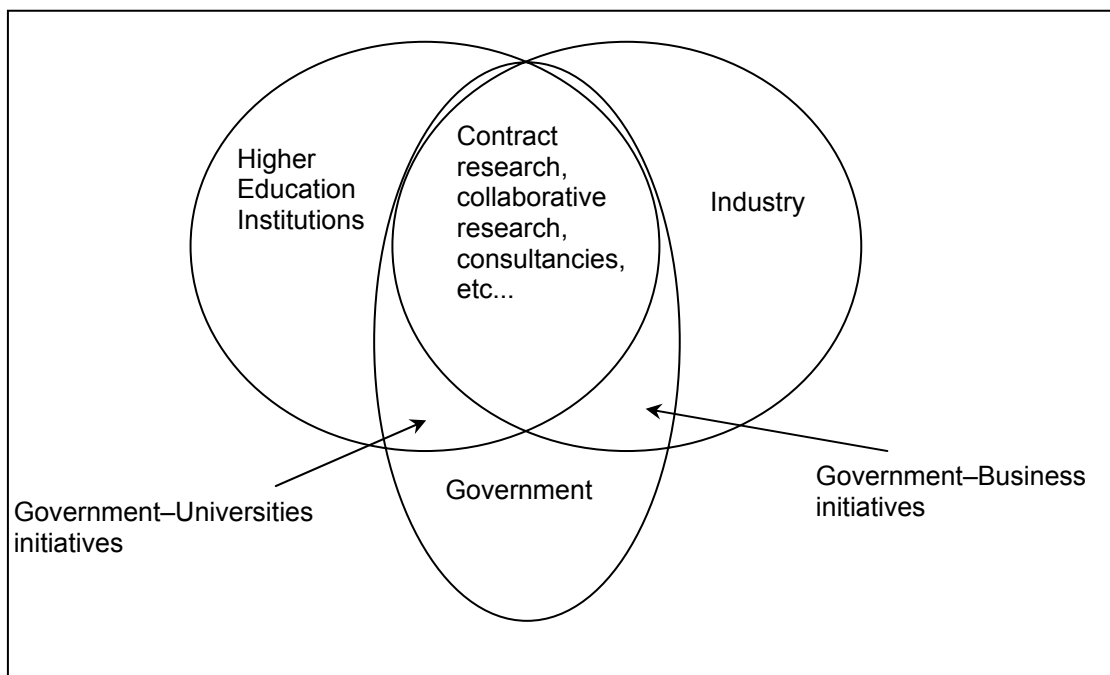


Figure 2.3: The “Triple Helix” of innovation system

## **2.4 CHANGES IN HIGHER EDUCATION SYSTEMS**

The social view of science brought a third mission to universities and the “Triple Helix” explained the contributions of academic research to industrial and societal developments (Etzkowitz, 1989; Gibbons et al., 1994; Geuna, 1997; Etzkowitz et al., 1998 and 2000; Clark 1998; Pilbeam, 2008). At national levels, new incentives were developed to reward the scientific work that responds to the third mission requirements (Etzkowitz et al., 2000; Nowotny, 2001; Geuna and Martin, 2003). At institutional level, new arrangements were made to respond to the new policy requirements (Connell, 2004; Hazelkorn, 2005). The next sub-sections discuss these developments.

### 2.4.1 Policy-level changes

At national levels, governments linked resources through competitive schemes and research priorities, and guided national funding towards particular fields of research (Middlehurst, 2004). Scientists were increasingly encouraged to leave their “Ivory Towers” and to look into social problems. In the European Union (EU), for example, Fifth, Sixth and Seventh Framework programmes placed more emphasis upon broader social objectives for research (Georghiou and Roessner, 2000). In UK, the UK HEFCE<sup>1</sup> introduced in 1999 a “third stream” funding specifically to support the Higher Education sector (Pilbeam, 2006). The aim was to increase their capability to respond to the needs of business and the wider community. A research “block funding” (distinct from funding for teaching activities) was allocated competitively using performance indicators in a general framework of research priorities and quality requirements (Kleeman, 2003).

As a result, public stakeholders with interests in the output of academic research started to interact with the science base to introduce their research agenda. Broader ranges of stakeholders started to measure the impact of university research on employment, health, quality of life and the environment. Universities were required to report research inputs and quality assurance responses (Geuna and Martin, 2003; Kleeman, 2003). Research funds (granting agencies and other sources), numbers of research student and their completion rates, completion of research projects and communication of outcomes including publication were all included in the evaluation of university research (Kleeman, 2003). Social and economical measures such as number of patents and collaboration with industry were also used. In 2009 HEFCE, for example, reviewed institutional research strategies and the nature of knowledge exchange activities (HEFCE, 2009). The report captured “third stream” activities in the nature of formal and informal interactions between institution's staff and students with external parties. The UK 2008 RAE considered business aspects,

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<sup>1</sup> HEFCE is the Higher Education Funding Council for England

including incentives for applied, practice-based and interdisciplinary research, and took into account users' views (DIUS, 2008; HEFCE, 2009).

In conclusion policy interventions guided public research towards intended outcomes and introduced a decline in the support of other research fields. In response to these interventions, Higher Education institutions aimed to attract maximum public support to compensate for the decline of public support. These are discussed next.

### **2.4.2 Changes at institutional level**

The political interventions placed significant accountability on universities in terms of effectively attracting resources as well as in terms of transparency that made them visible for social evaluation. To attract maximum public support, universities developed research strategies (Bushaway, 2003; Connell, 2004; Hazelkorn, 2005; Reichert, 2006) and started to measure their performance against national socio-economic research profiles (Hazelkorn, 2005).

To compensate for the decline of public support, a “market-like” behaviour or “entrepreneurial” activities emerged in universities (Slaughter and Leslie, 1997; Etzkowitz, 1998; Henderson et al., 1998; Duderstadt, 2000; Lambert, 2003; Kutinlahte, 2005; Van Looy et al., 2005; Pilbeam, 2008). The intellectual property (IP) developed by an institution's employees and/or the use of its resources and “know-how” services came under the spotlight.

In the next sub-sections the main institutional changes are discussed in more detail.

### **2.4.3 Strategic changes**

Institutions reflected the new socioeconomic requirements in their research strategies (Bushaway, 2003; Connell, 2004; Hazelkorn, 2005; Reichert, 2006). They identified niches, built research capacities and adopted internal resource allocation models. Priority setting, expansion of knowledge transfer activities

and national and international networking became major features of the research framework. For example, most the European universities adopted thematic priorities, enhanced interdisciplinary research, expanded knowledge transfer efforts and enhanced research income through networking and recruitment of active researchers (Reichert, 2006). Universities also started to measure the performance of their research strategies against research profiles that were linked to socio-economic development (Hazelkorn, 2005).

### 2.4.3.1 Transformation in research mode

The new social contract for science caused a movement from pure, fundamental research to more applied. The shift from basic to applied research had implications on the number of researchers involved in a single project and consequently the number of disciplines. Universities, therefore, witnessed a shift from a disciplinary, primarily cognitive context (Mode 1) to a broader interdisciplinary social and economic context (Mode 2) because a Mode 1 research approach does not solve problems (Gibbons et al., 1994; Arnold and Balázs, 1998). Distinctions between the two modes are summarised in Table 2.2. This transformation increased the complexity of the university system and consequently induced a higher risk of failure (Pasek and Farshid, 2002).

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<b>Mode – 1</b>	<b>Mode- 2</b>
Curiosity driven Research	Application driven research
Disciplinary research	Trans-disciplinary, multidisciplinary, interdisciplinary research
Homogeneous	Heterogeneous
Stable organization	More transient form of organization
Internal quality control	Socially accountable quality control

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Table 2.2: Distinctions between research Mode-1 and Mode-2 (Arnold and Balázs, 1998, with modifications)

Transition of university research from Mode 1 to Mode 2 has been extensively debated. However, mid-line scholars have emphasised that both modes co-existed and complemented each other (Martin and Etzkowitz et al., 2000;



Llerena and Meyer-Kramer, 2003; Martin, 2003). For example, Debackere (2000) studied a technology transfer unit called Leuven Research and Development (LRD) in the University of Leuven. LRD has an organizational concept called “Research Division” where researchers joined LRD while belonging to different schools or departments. LRD adopted an incentive system based of flexible budgetary and financial autonomy to facilitate multidisciplinary, Mode-2, research although Mode-1 research was still being conducted in individual departments.

The cutting edge research was increasingly multidisciplinary, but most universities research structures remained disciplinary based (Connell, 2004). Multidisciplinary research structures operated in parallel with departmental/ disciplinary structures in centres where staff were drawn from different disciplines and their substantive positions remained with their original department. Structures that gather researchers from different areas are thought to enable them to explore areas of common interest. Lambert (2003), however, surveyed industry, universities and intermediate organizations in the UK and stressed that industry found multi-disciplinary research was not sufficiently addressed in universities. There were no incentives for researchers to get into multi-disciplinary research. Lambert recommended that the research strategies of universities needed to stimulate multi-disciplinary structures and accept staff involvement in multidisciplinary research as suitable, if not preferable, for academic promotion.

#### **2.4.3.2 Research commercialization**

Resource dependency theory (Pfeffer, 1992) presupposes that decline in public support and incentives to universities forced them to secure other forms of funding (Slaughter and Leslie, 1997). The intellectual property developed by an institution’s employees and/or the use of its resources also came under the spotlight. In addition, the services and “know-how” that the universities could trade with the other players were considered. This “market-like” behaviour (Slaughter and Leslie, 1997) is also known as the “Entrepreneurial University”

(Etzkowitz, 1989; Clark 1998; Etzkowitz et al., 1998, 2000 and 2004; Pilbeam, 2008).

The “Entrepreneurial University”, in principle, encompasses a wide range of mechanisms for fostering commercial activities and academic entrepreneurship. University commercialisation activities covered formal cooperation with industry, university seminars, faculty consulting, industrial associate programs, industrial parks, spin-off firms and technology licensing (Slaughter and Leslie, 1997; Varga, 1998; OECD, 1999 and 2000; HEFCE, 2006 and 2009). For instance, HEFCE (2009) analysed the results of the 2007 survey of “Higher Education-Business and Community Interaction”. Universities' income from commercial activities was £1.942 billion. Contract research income was the greatest contributor 32% of the total. Collaborative research contributed 23%, specialist courses for industry and commerce 19% and consultancy contracts 11% of the total. The report considered income from regeneration and development projects as an index for socioeconomic impact and contributed 9% to universities' commercial income. Income from intellectual property related activities was only 2% in 2007 but showed an improvement from 0.63% in 2005 (HEFCE, 2006).

There are indications that universities and industry explored new avenues to generate new knowledge (Meyer-Kramer and Schmoch, 1998). However, academic culture, competences and resources are major factors for successful interaction with the other actors in the innovation process (Krücken, 2002; Jacob et al., 2003). For example, business found difficulty to determine what services and consultancies were available in universities (Lambert, 2003), but the challenges facing university-industry relations are beyond the scope of this study.

### **2.4.3.3 Governance transformation**

The classical collegial decision making style is preferred by, and may be still dominant, in many universities. Despite its importance, many pressures were

placed on universities to change it. The requirements of coherent policies, strategies and clear cut decisions made the use of this style problematic (Zaidman, 1997; Jacob et al., 2003; Hazelkorn, 2005; Pilbeam, 2006). Institutions have grown in size and complexity and established closer linkages with external organisations, including business, society and government. The increasing dependence on project funds and non-core grants, and the demands for public accountability for socio-economic returns enhanced this complexity (Connell, 2004; Hazelkorn, 2005). All of these forces induced the need for a stronger managerial approach in the light of the new social view of science and the triple helix relationship (Shattock and Berdahl, 1984; Taylor, 1987; Wagner, 1995; Lambert 2003; Connell, 2004; Hazelkorn, 2005).

The “Steering Core” of the university was reinforced by giving stronger authority to academic managers (Department Heads, Deans and Vice Chancellors (VCs)) (Clark, 1998). The VC’s job, for example, was directed towards becoming a chief executive, and strategic visionary of the institution. Many institutions established posts for Pro, Deputy or Assistant VCs with line management responsibilities which reinforce the “steering core” at different levels (Hazlekorn, 2005). According to Hazlekorn (2005), Pro-VCs developed research strategies and identified research priorities or multidisciplinary themes. They provided coordination across schools and Departments and linked them to administration in order to ensure compliance with national policies. This Mintzberg’s “Strategic Apex” in the “Corporate” culture was practiced where the roles of “managers” and “professionals” were separated (McNay, 1995; Pilbeam, 2008).

New structures within the institutions have emerged to meet the new requirements. Outreach administrative units and inter/trans-disciplinary research centres have become common structures. These units created different career paths such as full-time researchers (Middlehurst, 2004) and a demand for new positions (Heads of Division and Directors of Centres). These positions formed new “Academic Heartland” (Clark, 1998) or “Middle Line” Mintzberg’s organisation (Pilbeam, 2008) with a two-direction role; strategic at

university level and operational in a particular academic area. Business liaison and support was needed to link academic research to outside businesses or communities (e.g. research and technology transfer offices) (Krücken, 2002; Hazlekorn, 2005). An “Enterprise” culture was increasingly spread in universities. Client-customer relations were prioritised and decisions were oriented to customer needs and satisfaction (McNay, 1995).

Research and technology transfer offices required new skills to support consultancy, and knowledge transfer activities were aimed at growth of research capacity and capability. A culture of “Bureaucracy” (McNay, 1995) or “Techno-structure” or Mintzberg’s “Professional Bureaucracy” (Pilbeam, 2008) was also needed to regulate and standardise procedures. This side-line process or “Development Periphery” (Clark, 1998) strengthened the “Steering Core” and brought the “Academic Heartland” up within the institution. Management of research in these units involved collaborations and partnerships between the core activities of the “Academic Heartland” and the side-line “Periphery” to meet the needs of clients and markets (Middlehurst, 2004). As a result “two-hat” posts were created, e.g. a director of a research centre who was simultaneously an academic. These two-hat posts are now present in many universities such as Sultan Qaboos University (SQU) and the Catholic University of Leuven (Debackere, 2000; VanLooy et al., 2006).

A new way to justify the imposed managerial “business-profit” based techniques onto universities emerged; “managerialism” (Reed and Anthony, 1993; Clarke and Newman, 1997). “Managerialism” could take any organisational form, responding to the local culture and technologies of management (e.g. internal cost centres, competition between employees, measurement of activities and individual performances). Two types of “managerialism” were soon distinguished; soft and hard (Trow, 1994). Soft “managerialism” describes a common culture of efficiency and effectiveness where intention to improve university performance is agreed upon by all those involved (transformational leadership) (Kakabadse and Kakabadse, 1999). A long-term vision is created

and the project is carried forward by teamwork and hierarchies are minimised (Kakabadse et al., 2004).

Hard “managerialism” imposes control techniques and guides the operation by rewarding and punishing employees as per their performance (transactional leadership) (Kakabadse and Kakabadse, 1999). Transactional leadership is about the skill and ability needed to lead day-to-day operations (Kakabadse et al., 2004). In universities, the faculty size was reduced to smaller number of departments and Deans became line-managers and budget holders and Heads of Departments approached senior management through the faculty Dean. The committee system was slimmed down and the decision-making responsibilities of both the university’s council (governing body) and senate was redefined and clarified (Trow, 1994). Procedural processes for appointments and promotions of academics as well as their pay policies were used to enforce decisions or reinforce institutional priorities (Connell, 2004).

In conclusion, the developments in both political and institutional levels of the Higher Education systems imposed complex implications on universities of an international scale. The next section introduces Sultan Qaboos University (SQU) as a hosting cite for the present study.

## **2.5 SULTAN QABOOS UNIVERSITY**

In this section the Sultan Qaboos University (SQU) is introduced. Oman is also introduced to provide the reader with a better understanding of the context in which SQU finds itself. The developments discussed in the previous sections will be seen as relevant as the discussion progresses. This section draws to a great extent on the experience of the researcher who works in SQU’s research administration office.

### **2.5.1 Oman**

The Sultanate of Oman is the second largest country in the Arabian Peninsula, occupying an area of some 309,500 Km<sup>2</sup>. It is located at the eastern part of the peninsula. The population of Oman is about 2 million and the GNP per head is US\$ 14,872. The main industry in Oman is the oil and gas industry and the company Petroleum Development Oman (PDO) is the dominant one<sup>2</sup>.

In 1970 the Sultan Qaboos took over the rule of the country from his father. He immediately started to promote education and schools were built in all parts of Oman. In 1986 a public university was opened and was named after him, Sultan Qaboos University (SQU). Today it is still the only public university in Oman, however, since 2000 five private universities have opened. So far, SQU is the only one that conducts research.

### **2.5.2 Sultan Qaboos University**

SQU is financed and managed by the government of Oman. The total staff number is 3500. There are 800 academics out of which 58% are expatriates and 42% are Omanis. Expatriate staff come from more than 25 countries. There are 17,000 students, nearly all Omanis. Only 5% are postgraduates.

The annual turnover is US\$ 67million mainly from government. Research income is US\$ 4 million, 65% of which is government research grants and 35% research contracts with industry and public departments. Other commercial activities such as short courses, postgraduate studies and consultancies bring in US\$ 2.3 million.

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<sup>2</sup> See website [www.moneoman.gov.om](http://www.moneoman.gov.om)

### **2.5.2.1 SQU's mission statement**

SQU's research mission is to act as "The Consultancy House of Expertise" in Oman, as designated by His Majesty Sultan Qaboos. Thus besides its classroom teaching, the university aims to conduct outstanding research and provides consultancy services in areas vital to effective socio-economic development of Oman. SQU's charter<sup>3</sup> defines the main objectives of research and society service. SQU should:

- Foster basic and applied scientific research in service to Omani society.
- Assist in providing scientific solutions to socio-economic problems.
- Relate studies and research to the total development plans of the country and to the vision of the society.
- Prepare Omani scientists and experts who are organized and innovative in their work.
- Continuously and directly contact Omani public institutions and private organizations, aiming at providing consultancies and scientific advice to enable full utilization of the university's capabilities and expertise.
- Develop human resources and efficiency by providing continuous training for all Omani organizations.

The charter's duties were hardly acted upon when, in 2000, His Majesty visited SQU and explained that he expects SQU to act as a source of expertise to serve Omani needs by way of research and consultancy. He announced annual financial support to research in SQU.

### **2.5.2.2 Governance of SQU**

SQU Council is chaired by the Minister of Higher Education. Various groups of people such as businessmen and lawyers and sectors such as society, industry

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<sup>3</sup> See website [www.squ.edu.om](http://www.squ.edu.om)

and local enterprise are represented in the Council. The council also includes two members representing the SQU academic community. The Council reviews and approves policies, strategies, regulatory bylaws and their amendments, development plans and annual budgets. The SQU VC has three deputies, one for Administration and Finance affairs, one for Academic affairs and Community Services and one for Postgraduate Studies and Research. The VC chairs the Academic Council which reviews all proposals before submission to the University Council. Colleges are represented on the Academic Council by their Deans, to promote collegial input in decision making processes.

Administrative and financial issues are followed by the Deputy VC for Administration and Finance affairs. This includes all communications with external stakeholders in relations to the administration and financing of the university. The Deputy VC for Academic affairs and Community Services looks after academic related matters and short courses. Colleges Deans report to him/her and this is their only official channel by which to approach the VC. The Deputy of VC for Postgraduate Studies and Research has the Deanship for Postgraduate Studies and Deanship for Research and Research Centres. These Deanships facilitates postgraduate programs and their student affairs. The Research Deanship supports researchers through research administration, contract negotiations and intellectual property affairs.

The Research Centres coordinate multidisciplinary research. University research centres are set up to tackle topics of importance to Oman such as oil and gas, water and environment. Each centre has a director reporting to the Deputy VC. The director is usually an academic who works 50% of his/her time for the centre. Further an Administrative Committee oversees the operation of each centre in forming research partnerships with industry and government in its own particular field. The main mission of these centres is to coordinate the formation of multidisciplinary research teams from university personnel to carry out strategic research and research contract projects. At the moment less than 5% of the university research is conducted at these centres. The ultimate goal



of each centre is to become a “Centre of Excellence” with high-class facilities offering research and technical services to its clients.

### **2.5.3 Colleges of SQU**

SQU consists of eight Colleges: Engineering, Agriculture and Marine Sciences, Medicine Sciences, Science, Commerce and Economy, Education, Arts and Social Sciences and Law. Deans have two Assistants, for undergraduate studies and postgraduate studies and research. Deans of the Colleges of Engineering and College of Agriculture and Marine Sciences have an Assistant for industrial relations to strengthen the College’s linkages with various industries. Each college has its own buildings and full-time staff. Most of SQU research is conducted in laboratories located in the colleges. Each college manages its own budget but expenditures are processed centrally.

Assistant Deans for Postgraduate Studies and Research (AD-PSR) chair College Research Committees (CRC). The roles of these committees are discussed in Sub-section 2.5.3.2.

#### **2.5.3.1 Research funding in SQU**

In 2000 SQU started to fund research internally in the so-called Internal Grant (IG) scheme sourced from its commercial income. The financial support announced by His Majesty established a new funding scheme known as the Strategic Research (SR) funds. SQU manages both IG and SR funds from pre-awarding stage to close out, however there are differences between the two (Table 2.3).

Many academics assume that the IG is to support basic research but there is no evidence in SQU’s charter for such assumption. In fact some applied research projects have been funded from this scheme. Moreover the Research Department has advised some researchers who wishes to apply for SR, to apply first for an IG to do pilot studies before proceeding to SR. The IG performance measurement process emphasises the relevance of the research

to Oman and possible applications. In addition emphasis is also given to external support that the project has established for further research (see Forms; 6 and 7 in Appendix A).

<b>Difference</b>	<b>I G Research</b>	<b>S R Research</b>
Average number of projects per year	70 projects	4 projects
Funding source	SQU commercial income	His Majesty's fund
US \$ per year	1.3 million	1.3 million
Evaluation	Peer review	Peer and ministries reviews
Approval	Deputy VC for Postgraduate Studies and Research	Committee chaired by the VC
Reporting	Form 7	Form 7 plus oral presentation

Table 2.3: Summary of the differences between IG and SR research in SQU.

### **2.5.3.2 Administration of research in SQU**

The SR and IG funds differ in their administrative and reporting procedures. This section highlights administration processes used. The discussion refers to some forms that can be found in Appendix A.

#### **2.5.3.2.1 Research department**

A Research Department in SQU's set up is equivalent to research support offices in a UK university. The department is the university's central unit that looks after all funded research activities as well as research contracts. For IG and SR, the department coordinates peer reviews, obtains approvals from authorities and administers requests for research purchases.

#### **2.5.3.2.2 Administration of IG research projects**

IG administration is centralised. However colleges can choose to fund one big project or many small pilot studies. Research proposals (Forms 1 & 2) are submitted to the Head of Department (HoD) for endorsement. Endorsed

proposals are submitted to the College Research Committee (CRC) for screening and approval. Approved proposals are forwarded to the Research Department to review administrative and budgetary compliances. Research Department processes peer reviews through Form 3, and informs applicants accordingly. After necessary amendments, applications are forwarded to the Deputy VC for Postgraduate Studies and Research for approval.

Once a research is approved, purchase requests are reviewed and processed by the Research Department to ensure administrative and financial compliances with accordance to SQU regulations. Approved requests are sent to the Accounts Department for payment transactions. Annual research budgets are not activated without submission of an annual progress report (Form 5). Upon completion of the project, researchers must submit final reports (Form 7) to CRC. The latter uses Form 6 to evaluate progress and final reports and advises Research Department on project close out.

#### **2.5.3.2.3 Administration of SR research projects**

Once reviewed by the CRC, SR proposals are submitted to the Research Department for evaluation. The evaluation includes reviews for scientific merit, administrative compliance and strategic evaluation. In strategic evaluation, proposals are sent to government departments and ministries to evaluate the relevance to Oman. To corroborate the evaluation, a higher committee formed by the VC and his deputies reviews all the applications for final approval.

Similar to IG research, purchase requests are reviewed by the Research Department and sent to the Accounts Department. Annual progress and final reports are submitted to CRC. In addition, researchers are requested to present research progress orally to a review committee. This committee is assigned by the Deputy VC for Postgraduate Studies and Research. Progress of all SRs is summarised to His Majesty in annual reporting.

## 2.6 RATIONALE

The social view of science, the “Triple Helix” and the consequent third mission of universities have caused a transition in Higher Education systems (Etzkowitz, 1989; Gibbons et al., 1994; Geuna, 1997; Clark 1998; Etzkowitz et al., 1998 and 2000; Pilbeam, 2008). SQU is facing an increasing demand not only for research output but also consideration of upfront relevance during the research allocation process. Ministries demand solution of particular problems of a public nature. Economic sectors demand the development of commerce, and industry needs qualified researchers in specific fields.

SQU, like other universities, aims to satisfy national requirements of research performance (Geuna and Martin, 2003). Recently the Ministry of Finance requested SQU to prove that its research assists the socio-economic development in Oman in line with its mission. The Ministry made a reply to its request a condition for further public funds for SQU research. However, SQU was not in a position to respond. There were various causes such as the lack of records in the hands of the administration, SQU is not itself convinced about its research relevance to Oman, and previous experience of miscommunication between managerial and professional staff.

Despite the limited size of the IG fund, about 45% is not spent. Various reasons might have caused this. Poor project management skills on the part of the applicants could be a reason. Another cause might be that academics secure IG fund only to list them on their promotion applications with no intention of doing the actual work, or that after approval researcher gave up their research because it is too much of a burden.

To this end, the aim of this study is to explore how to improve performance of research in SQU. It is acknowledged that SQU’s position is unlike that of most universities (see Table 2.4). However research of SQU may benefit from private R&D activities. Like business, SQU operates in a marketplace even though it is an institutional organisation. SQU deals with shareholders (government) and other stakeholders as in business. It distributes its own research funds and has

a research mission to serve country's needs. Table 2.4 summaries the position of SQU in comparison to UK universities and private business. It is therefore fruitful to explore the literature on private R&D and see how it can assist in building a framework for this study.

	<b>UK universities</b>	<b>SQU</b>	<b>Companies</b>
<b>Mission</b>	High quality science + 3 <sup>rd</sup> mission	High quality science + Benefit to Oman	Own/shareholders benefits
<b>Research Funds</b>	Public & private contracts	Public & private contracts	Internal
<b>Selection of projects</b>	External	Internal	Internal
<b>Monitoring of projects</b>	External	Internal	Internal
<b>Success measures</b>	RAE, future funds	?	Internally defined

Table 2.4 Differences and similarities: SQU, UK universities and companies.

### 2.6.1 Management of R&D in business

Historically, private R&D was driven by intellectual curiosity until the mid 1950s. Business adopted the basic principles of project management in the 1950s to 1960s in what is now called the first generation of R&D management. R&D then lacked a strategic framework and as a result it was considered an overhead cost (Roussel et al., 1991). Few formal techniques were available to this generation for selecting and evaluating R&D projects (Liyanage et al., 1999). Approval R&D projects were judged on the basis of perceived importance of the anticipated results of the projects. The generated knowledge was then diffused in the market through the development of new products<sup>4</sup>.

<sup>4</sup> Rothwell (1994) suggested five generations of innovation management. Rothwell separated Liyanage et al.'s first generation into two; the first with rapid economic growth and the second with steady economic growth.

In the 1970s and 1980s private firms adopted the concept of aligning R&D efforts with market-driven objectives and strategies. The R&D unit worked with other units of the firm in a customer-contractor relationship with emphasis on knowledge generation. This concept is regarded now as the second generation of R&D management. R&D responded to both models of knowledge production; science push and market pull. The second generation provided a framework for R&D at the project level and built better communication channels between R&D managers and business managers. Further, it acted on the discrete nature of the R&D project and used matrix management. It assigned professionally trained or experienced project managers in charge of projects (Mowery, 1979). But even then R&D was, still considered a unique and unstructured activity which it was almost impossible to monitor and control (Kerssen-van Drongelen and Cook, 1997).

Many studies (such as Cooper, 1979 and 1980) attempted to discover the critical factors that can lead to successful R&D projects and new product developments. For example, in the late 1970's and early 1980's, Cooper (1980) carried out an exploratory study into success versus failure in R&D projects. He identified those characteristics that separated 102 new product successes from 93 failures in 102 firms. Studying what successes shared in common, and how they differed from failures, he uncovered some critical success factors. Such efforts led to the emergence of a third generation of R&D management (Roussel et al., 1991). In this generation, corporate and R&D strategies were linked. The R&D function was considered accountable for its efficiency, effectiveness, internal and external customer focus and alignment to corporate and business strategies (Kumpe and Bolwijn, 1994; Pearson, 2000). Consequently R&D units used common language with other units. The fundamental, incremental and radical research terms were used instead of "basic" and "applied" research. Improved communications between research personnel and corporate managers integrated organisational strategic and operational functions. The third generation focused the firm's attention on R&D's contribution to its competitive advantage.

More studies to uncover determinants of successful R&D were conducted in the 1990s (see Cooper and Kleinschmidt, 1993, 1995 and 1996; Cooper, 1994; Griffin and Page, 1996; Balachandra et al., 1996). Towards the 21st century, a fourth generation of R&D management emerged (Liyanage et al., 1999). It was characterised by endogenous and exogenous R&D management. The endogenous R&D management managed creativity which is the most important input for business and technology improvement (Roome, 1994). This was addressed in the third R&D generation. The exogenous R&D management managed the network linkages and knowledge exploitation in joint venture, strategic alliances and research links and collaboration. The exogenous R&D management introduced knowledge management issues at the boundaries between different firms, industries and other research institutions. This, however, has increased the complexity and risk of failure (Pasek and Farshid, 2002).

The basic characteristics of different generations of R&D management are highlighted in Table 2.5. The recent changes in academic research follow to some extent the developments in private R&D, Figure 2.4. A similar study in a Higher Education context, to those conducted in private R&D, may help uncover the determinants that lead to successful academic research.

<b>Generation</b>	<b>Management Character</b>	<b>Specific Features</b>
<b>First</b>	Incremental resource allocation Management of R&D as an entity	Science push strategy Mix project portfolio Unlimited time horizons Ease in resource allocation issues Individual researchers
<b>Second</b>	Project management Project quality	Market pull strategy Project focused Better project evaluation methods Project quality and micro-management of projects
<b>Third</b>	Business strategy links Research planning as a corporate	Strategically balanced project portfolio Links with business strategy Partnerships business Function integration processes and strategic management of R&D and business
<b>Fourth</b>	External and internal knowledge management Managing research networks and collaborations Strategic research alliances Linking research, technology and innovation management	Strategic management of knowledge Knowledge organization and external knowledge sources. Linking internal and external knowledge managing information flows communication patterns Networks and linkages Organizational relationships Communication strategies and interactions among firms. Integration between research production, and innovation systems

Table 2.5: Basic characteristics of different generations of R&D management, source Liyanage et al., (1999).



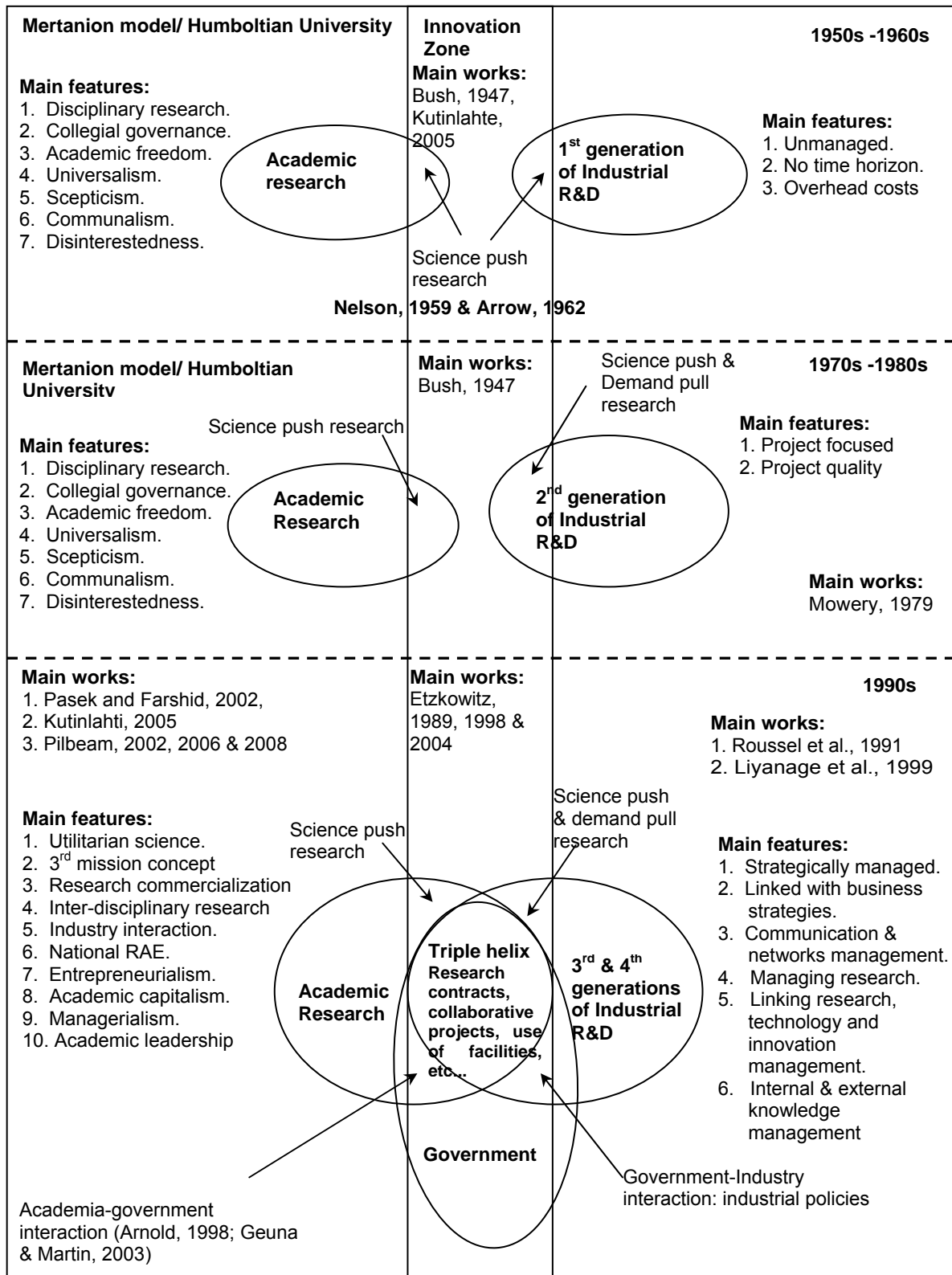


Figure 2.4: Developments in industrial and academic research as perceived from the literature.

## 2.7 SUMMARY

The importance of knowledge for economic growth has been known since the seventeenth century. However political interventions to harness it came after the Second World War. The new social contract of science caused the movement from linear flow of technology to “Triple Helix” relationship between university, industry and government. Higher Education policies used different approaches to direct academic research towards desired fields and outcomes. Consequently university research mode is shifting from uni-disciplinary to multidisciplinary nature. Universities trade their intellectual and assets possessions and maintain stronger linkages with industry and private firms.

The rationale of this study has been discussed. Because of its similar scientific nature, university research may benefit from the developments of private R&D though there are differences between them. Studies in private R&D found certain common features among successful projects and other features among failed ones. A similar study in an academic context may uncover critical factors that lead to successful academic research. The next chapter (Literature review) discusses the studies that were carried out to determine success determinants in private R&D and related fields.

## 3 LITERATURE REVIEW

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### 3.1 INTRODUCTION

This chapter reports the literature review on success and its attributes of R&D projects. First, it sets a terminological platform for the paper. Next, a model for R&D success measures was considered to answer public concerns on academic research. Identified effects on R&D performance are, then, presented in a matrix format. These effects are categorised in a four-category structure to ease the analysis. R&D Models are then reviewed. To understand the nature of implementation, in general, the literature of strategy and change implementation is considered. Finally the way forward is identified.

### 3.2 OPENING REMARKS

The term “Research” present in Research and Development (R&D) overlaps with many fields such as New Product Development (NPD), New Service Development (NSD), Information Technology Acquisition (ITA), Manufacturing Technology Acquisition (MTA) and Innovation projects in general. Therefore the literatures of these fields are reviewed here to obtain a more comprehensive understanding of the nature of the scope of the problem involved.

In this thesis, “Research” refers to creative work undertaken on a systematic basis to increase the stock of knowledge (OECD, 2008). A classification framework of basic research, applied research and experimental development is provided by OECD (OECD, 1981). This classification was later refined to sub-divide research into pure research and strategic research (Irvine, 1984). Strategic research covers research undertaken by most government laboratories and large science-based companies and may be applied in nature.

At the stage of discovery of new knowledge (invention) academics used to publish acquired knowledge to receive their academic rewards. Researchers in non-academic environments extend their efforts beyond the invention stage (Roberts, 2009). They enter into the “Development” stage where inventions are used in new applications (Roberts, 2007; OECD, 2008). Despite the long debate on “Innovation” (see Goffin and Mitchell, 2005; Chang, 2006; Roberts, 2007), it could be seen as the sum of the two processes “Research” and “Development” (Roberts, 2007). An innovation is not necessarily invented and used for direct economic benefits (Goffin and Mitchell, 2005). Education and other social institutions may utilise new knowledge to improve their processes. Figure 3.1 summarises these stages in the innovation process.

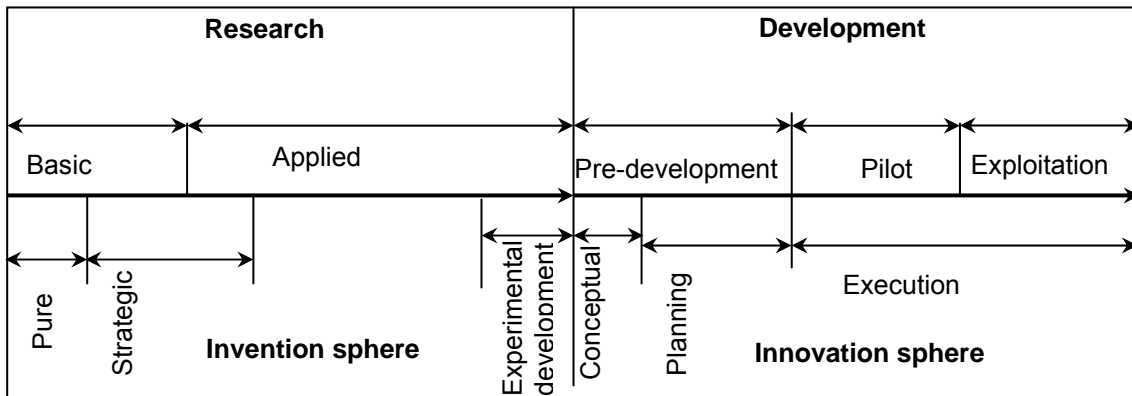


Figure 3.1: Linguistic platform for the present study, by the author.

Implementation is the process of turning tacit and/or implicit ideas into reality. In business and technical fields implementation refers rather to the execution processes of developed plans (Goffin and Mitchell, 2005). In this study implementation refers to the whole R&D process.

“Success Factors” and “Success Determinants” are phrases are used to describe the effects of implementation processes on R&D outcomes. The assumption is that consideration of success factors in the implementation processes delivers successful projects. The use of these phrases and “Implementation Effects or Factors” refers to the same thing.

Research projects in general are unpredictable and their objectives may not be achieved yet their results may open a new market and hence success for organisations (Pilbeam, 2002). The definition of success in R&D project is contextual (Olson et al., 1995) and depends on the type of innovation (Green et al., 1995; Balachandra and Friar, 1997). This dictates the need to explore both performance measures as measurement criteria and success factors as attributes to successful performance. Next sections review definition of R&D success as seen by previous work.

### **3.3 SUCCESS MEASURES**

In some works, success was market share (Rothwell et al., 1974; Utterback, 1974; Freeman, 1982; Rothwell, 1985; Baker et al., 1986; Ulrich and Eppinger, 1995; Griffin and Page, 1996). In other works it was the creation of new opportunities (Cooper and Kleinschmidt, 1987; Urban et al., 1986), technical advantage (Pinto and Slevin, 1987; Freeman and Beale, 1992; Lipovetsky et al., 1997) or customer satisfaction (Paolini and Glaser, 1977; Pinto and Slevin, 1988; Von Hippel, 1989; Lipovetsky et al., 1997). More recent works combined measures to define success. Combinations included financial, market share, technical and strategic dimensions (Cooper, 1990 and 1994; Cooper and Kleinschmidt, 1995 and 1996), successful execution and perceived value of the project and customer satisfaction (Pinto and Covin, 1989). Ottenbacher et al. (2006), for example, used a list of ten measures to define success of NSD projects.

- total sales
- enhanced profitability and sales of other hotel services
- market share
- positive employee feedback
- profitability
- competencies of employees
- improved loyalty
- customer satisfaction

- improved image
- cost efficiencies
- opened up new markets
- attracted new customers

In the academic context, Arnold and Balázs (1998) reviewed the literature of university research. They highlighted three general categories for evaluating academic research; output, outcome and impact. Outputs are direct results in terms of scientific merit, educational outputs and technological results. Outcomes are internal changes and benefits that may result from the outputs. These benefits could be development of new products, services, processes, patents and technological awareness. Impact is the effect of outputs and outcomes on a broader environment. This includes the impact on scientific community, non-research effects on educational provision and on socio-economic needs. In the UK, for example, the Higher Education Active Community Fund (HEACF) focuses on specific aspects of community services and developments. The assumption is that this initiative would create outputs such as scientific results and educational outputs (HEFCE, 2009). These outputs would make internal changes and benefits (outcome) which would lead to an impact on the broader environment. These categories may set a general framework but how to translate them into specific measures remain unclear.

The concern of insufficient benefits of biomedical and health research led the National Health Services (NHS) in the UK to establish an R&D Programme in 1991 and an Implementation Methods Programme (IMP) in 1994 (Hanney et al., 2004). In 1995 the IMP funded 36 projects. Health Economics Research Group (HERG) at Brunel University evaluated projects that were completed. The evaluation covered: the quality of outputs; lessons to be learnt about communication strategy and commissioning process; and the benefits or payback from projects. HERG devised a multi-dimensional payback model for the evaluation of medical research. This model has five main categories:

- **Knowledge production** is a more classical assessment of the scientific contribution of the research project in terms of publication and means of bibliometric measures.
- **Future research, capacity building and absorption.** This is more about the continuity of research as seen from citation indices and research training as a result of the employment of personnel in research projects and/or through explicit funding for training and career development.
- **Informing policy and product development** which could take a wide range of forms at national or local levels.
- **Health benefits** in terms of health gains such as greater effectiveness of health-care, informed drugs or procedures that lead to improved health.
- **Broader economic benefits** from the commercial exploitation of research which could be in the form of employment, financial profits from manufacture and trade and/or IP related income.

HERG's payback model is a good attempt to satisfy public concerns on the accountability of academic research. However it was applied only to medical and health services research. It needs to be explored in the university context where other disciplinary fields exist.

### **3.4 ATTRIBUTES OF R&D SUCCESS**

Studies have attempted to discover critical factors for R&D performance by observing successful and/or unsuccessful projects. The first investigation of R&D success factor was a SAPPHO<sup>5</sup> project (SPRU, 1972). It compared 43 pairs of successful and unsuccessful projects in the same industry. For each project, interviews were used to explore the influence of factors such as government financial support, a project champion, etc. on the outcome of an

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<sup>5</sup> SAPPHO refers to Scientific Activity Predictors from Patterns with Heuristic Origins. The project was carried by the Science Policy Research Unit (SPRU) of Sussex University in the U.K.

R&D project. Correlative analysis was then used to determine which factors were associated with success and which ones with failure. This approach has been known since then as “Success Factor Approach” or SAPPHO approach.

Cooper and his colleagues used the SAPPHO approach in their “NewProd” projects. Cooper (1979 and 1980) explored success versus failure in NPD projects. He separated 102 new product successes from 93 failures in 102 industrial firms. Cooper found that out of 18 factors, eleven were significant. He grouped the significant factors under three headings; product, market knowledge and marketing proficiency, and technical and production synergies. Cooper and Kleinschmidt (1987) surveyed 203 projects (123 success and 80 failures) in 125 companies and found nine key factors. In 2001 Cooper (2001) summarised his experience of NPD success factors in a broader list of fifteen categories. His list included superior products, strong market orientation, international orientation, predevelopment work, product definition, proper launch, organisation structure, top management support, leverage competencies, attractive markets, monitoring (go/kill) processes, quality of execution, resources availability, speed to market, multi-stage process.

Jawad (1995) studied what influenced the outcome of ITA projects and found 43 factors and eight measures. Twelve factors and two measures were newly identified. Correlation analysis (of the 43 factors to the 8 measures) found 15 factors that were related directly to success. Mallon (2002) examined what factors contributed to success and failure in MTA. He found 75 factors and 38 measures for success. Six factors and seven measures were newly derived. The 75 factors were grouped into 9 broader categories while the 38 measures were grouped into 7 broad categories.

Ottenbacher et al. (2006) used factors and measures generated from the literature (of NPD and NSD) and personal interviews. A questionnaire was developed and sent out to 480 managers in hospitality sector and eight hotel managers were interviewed (183 responses to the questionnaire represented a 38 percent response rate). 23 factors were identified as potential determinants but only seven distinguished successful from less successful NSD.



The literature on R&D identifies many factors that can contribute to the success of R&D project (see Cooper, 1979, 1980, 1981, 2001 and 2005; Paolini and Glaser, 1977; Hopkins, 1981, Booz, et al., 1982; Maidique and Zirger, 1984; Yoon and Lilien, 1985; Cooper and Kleinschmidt, 1987, 1993 and 1996; Craig and Hart, 1992; Abratt and Lombard, 1993; Jawad, 1995; Balachandara et al., 1996; Griffin and Page, 1996; Balachandara and Friar, 1997; Goldenberg et al., 2001; Krishnan and Ulrich, 2001; Mallon, 2002; Ernst, 2002; Herzberg, 2006; Ottenbacher et al., 2006; Jimenez-Jimez, et al., 2008; Johnson and Luo, 2008; Buganza et al., 2010; Henard and Dacin, 2010). R&D success depends on various implementation factors such as the technology used, the environment surrounding the activity and organizational capacity (Smith-Doerr et al., 2004). The effects (positive or negative) of these factors are still not clearly understood (Damanpour, 1991; Kumar et al., 1996; Shenhar and Dvir, 1996; Balachandra and Friar, 1997). Balachandra and Friar (1997), for example, found conflicting results where some factors such as “rate of new product introduction” and “number of end-users” contributed to success in some R&D projects while they contributed to failure in others. It could be that some factors are not directly influencing success. Pilbeam (2002) for example found that “time” was neutral as all projects were time-scaled but in conjunction with “poor planning” it characterised less successful projects.

Studies have found large and unmanageable numbers of potential factors. These have been reduced to smaller but broader numbers of categories. Individual researchers assigned factors into categories based on the assumption that these factors affect or describe those categories. Cooper (1980), for example, used a framework consisting of market, process, and product. Craig and Hart (1992) used process, management, company, people, strategy and information. Cooper and Kleinschmidt (1995) and Ernst (2002) used internal perspective to classify factors into five broader categories; NPD process, organisation, culture, role and management commitment and strategy. Balachandra and Friar (1997) used external perspective to classify their findings into four broader categories; market, technology, organisation and environment. They argued that

*“To provide a better understanding of the phenomenon, we categorized the large number of factors that determine success using a variant of the method used in marketing strategy studies to structure information” (Balachandra and Friar 1997, p 277).*

Ottenbacher et al. (2006) used four dimensions; product, market, process and organization. In an academic context, Pilbeam (2002) grouped many success characteristics into twelve “Sub-categories” where the factors described the properties of the “Sub-categories”. He then grouped the twelve “Sub-categories” into five broader categories. The latter included the problem itself, support, structure, personnel interaction and the outcome of the activity, as dimensions to view success factors.

Despite the diverse categories of success factors in the literature, they all seem to reflect the processes of R&D implementation. Market (Cooper, 1980; Balachandra and Friar, 1997; Ottenbacher et al., 2006) and environment (Balachandra and Friar, 1997) influence the formation and implementation of R&D strategy (Cooper and Kleinschmidt, 1995; Ernst, 2002). R&D strategy guides idea generation and projects screening (Cooper, 1980 and 2001; Pilbeam, 2002; Ottenbacher et al., 2006). R&D project are affected by the process of administration and management (Cooper, 1980 and 2001; Craig and Hart, 1992; Cooper and Kleinschmidt, 1995; Ernst, 2002; Ottenbacher et al., 2006), and structure, culture, resources, team composition etc., (i.e. the organisation) (Craig and Hart, 1992; Cooper and Kleinschmidt, 1995; Balachandra and Friar, 1997; Ernst, 2002; Ottenbacher et al., 2006).

In this study, a comprehensive list of 221 success factors (Table 3.1) has been extracted from the literature review. Factors that influence success in a positive manner are coded “+” (e.g. Communication), factors that have negative influence are coded with a “-” (e.g. Complexity of product), and factors that have "neutral" influence are coded with a “ \* ” (e.g. Multidisciplinary). The list is diverse and difficult to manage, however the 221 factors are grouped in 22 sub-categories. The factors seem to define the properties of the sub-categories but 22 is still too large a number to manage.

Various frameworks could be used to present the 22 sub-categories. Previous work structured success factors around the process of R&D implementation which could be used here. From an implementation perspective a project starts as an idea that formulates into a R&D scope. This makes the factors related to an R&D idea (e.g. sources of the idea) of significance. The sub-categories “Source of idea”, “End user”, “Nature of task”, “Clear goals”, “Planning”, and “Results” influence the quality of the task (Jawad, 1995; Cooper, 2001; Goldenberg et al., 2001; Mallon, 2002; Pilbeam, 2002; Goffin and Mitchell, 2005). They are therefore categorised under “**Task or Project**”. An R&D strategy is needed to provide guidance and to screen ideas accordingly. The sub-categories “National Policy”, “legal”, “Environmental support”, “Market” and “Environmental stability” are external factors that influence formation and implementation of R&D strategy (Jawad, 1995; Balachandra and Friar, 1997; Cooper, 2001; Mallon, 2002; Pilbeam 2002; Goffin and Mitchell, 2005; Millson and Wilemon, 2008; Stendahl, 2009). Hence, they are grouped in the category “**Strategy**”. Once a concept is approved, responsibility lays within the R&D team. The sub-categories “Team composition”, “Motive” and “Skills” influence team performance (Booz et al., 1982; Brown and Eisenhardt, 1995; Balachandra and Friar, 1997; Ernst, 2002; Pilbeam, 2002; Goffin and Mitchell, 2005; Harmancioglu, 2007; Barczak et al., 2009). They are, therefore, grouped under the category “**Team**”. It is thought that team related factors need to be tackled separately as the team forms a “Sub-organisation” in the organisation. This “Sub-organisation” cannot succeed if the organisation and its management are not supportive enough. The sub-categories “Culture”, “Resources”, “Clear business objectives”, “Leadership”, “Management”, “Communication” and “process” influence the performance of the “**Organisation**” (Balachandra and Friar, 1997; Cooper, 2001 and 2005; Ernst, 2002; Mallon, 2002; Pilbeam, 2002; Goffin and Mitchell, 2005; Harmancioglu, 2007; Barczak et al., 2009).

## Literature Review

Factor	Sub. Cat.	Private					Academic research	Reference
		R&D	NPD	NSD	MTA	ITA		
<b>Strategy</b>								
<b>National policy</b>								
1	Policy/ Social Factors	NAPL	*				-	Merrifield (1981), Balachandra & Friar (1997) and Pilbeam (2002)
2	Public interest in product	NAPL	*				+	Carter (1982), Balachandra & Friar (1997) and Pilbeam (2002)
3	Government Regulations	NAPL	*					Balachandra and Raelin (1984) and Balachandra & Friar (1997)
<b>Legal</b>								
4	Patenting	LEGL	+	+		+		Carter (1982), Balachandra & Friar (1997) and Mallon (2002)
5	Comprehensive contract terms	LEGL					*	Jawad (1995)
<b>Support</b>								
6	Patent Attorney skills	SUPP				+	+	Jawad (1995) and Mallon (2002)
7	Confidence in suppliers competence	SUPP				+	+	Jawad (1995) and Mallon (2002)
8	Frequency of contact	SUPP				-		Mallon (2002)
9	Co-ordination of Suppliers	SUPP				-		Mallon (2002)
10	Client-supplier relationship	SUPP				*	+	Jawad (1995) and Mallon (2002)
11	Use of independent consultant	SUPP					*	Jawad (1995)
<b>Market</b>								
12	Price competition	MAR			+			Ottenbacher et al. (2006)
13	Competitive Environment	MAR	+	*	+			SPRU (1972), Rothwell (1977), Cooper (1979), (1981) and (2001), Cooper and Kleinschmidt (1993), Carter (1982), Balachandra and Friar (1997) and Ottenbacher et al. (2006)
14	Few Competitors	MAR	+	+				Carter (1982); Cooper (1980), (2001) and (2005), De Brentani, (1991), Ernst (2002) and Stendahl (2009)
15	Feasibility study/ Market attractiveness	MAR		+	+		*	Carter (1982), Maidique and Zirger, (1984), Cooper (1980), (2001) and (2005), De Brentani, (1991), Ernst (2002) and Stendahl (2009).
16	Industry Restructure Opportunity	MAR	*					Balachandra and Raelin (1984) and Balachandra & Friar (1997).
17	Miscellaneous Events	MAR				+	+	Mallon (2002) and Pilbeam (2002)
18	State of Industry	MAR				-		Mallon (2002)
19	Market Existence	MAR	+	-				Balachandra and Raelin (1984), Carter (1982) and Hopkins (1981).
20	Rate of new product introduction	MAR	*		+			Balachandra and Raelin (1984) and Ottenbacher et al. (2006).
21	Growing markets	MAR	+		+			Balachandra and Friar (1997), Cooper (1981) and (2001) Ottenbacher et al. (2006)
22	Slow growth market	MAR		-	-			Cooper (1981) and Balachandra and Friar (1997).
23	Strength of market	MAR		+	+			SPRU (1972), Rothwell (1977), Cooper (1979), (1981) and (2001), Cooper and Kleinschmidt (1993), Carter (1982), Balachandra and Friar (1997) and Ottenbacher et al. (2006)
<b>Stability</b>								
24	Changing organizational culture/Env.	STAB	*				-	Carter (1982), Balachandra & Friar (1997), Pilbeam (2002) and Stendahl (2009).
25	Public interest in product	STAB	*				+	Carter (1982), Balachandra & Friar (1997) and Pilbeam (2002)
26	Environment / Change	STAB				+	-	Mallon (2002), Pilbeam (2002) and Stendahl (2009).
27	Stable user requirements	STAB	+		+		+	Cooper (2001), Mallon (2002) and Ottenbacher et al. (2006)

## Effects of R&D Implementation on the Performance of Publicly Funded Research in SQU

Factor	Sub. Cat.	Private					Academic research	Reference	
		R&D	NPD	NSD	MTA	ITA			
28	Response to changes in customer's needs	STAB		*	*			Ottenbacher et al.( 2006)	
29	Accurate statement of requirements	STAB					*	Jawad (1995)	
30	Perceptions	STAB	+	+		*		Cooper (1981) and (2001), Maidique and Zirger (1984), Balachandra and Friar (1997), Ernst (2002), Goffin and Mitchell (2005) and Henard and Dacin (2010).	
<b>Organisation Culture</b>									
31	Risk taking and distribution	CULT	+	+				Rothwell et al. (1974), Balachandra and Friar (1997), Ernst (2002), Goffin and Mitchell (2005), Ottenbacher et al. (2006) and Stendahl (2009)	
32	Early to market	CULT		-				Maidique and Zirger (1984) and Balachandra and Friar (1997),	
33	Senior managt. project accountability	CULT		+				Cooper (1984) and (2001) and Ernst (2002)	
34	Demand for quick results	CULT	*					Balachandra and Friar (1997)	
35	Internal competition	CULT	+			+		Balachandra and Raelin (1984), Balachandra and Friar (1997) and Mallon (2002)	
<b>Resources</b>									
36	Sufficiency of financial resources	RESO		+		+	*	+	Cooper (1993), (2001) and (2005), Krishnan and Ulrich (2001), Goffin and Mitchell (2005), Herzberg (2006), Ottenbacher et al.,(2006), and Buganza et al. (2010), Jawad (1995), Mallon (2002) and Pilbeam (2002)
37	Overall project/company resources	RESO		+	+			+	Cooper (1981), (1984), (2001), Goffin and Mitchell (2005) and Pilbeam (2002)
38	Computer controlled	RESO					*		Mallon (2002)
39	Use of current technology/ Off-the shelf	RESO	+	+	+	+	+		Cooper (1993), (2001) and (2005), Jawad (1995), Krishnan and Ulrich (2001), Mallon (2002) Goffin and Mitchell (2005), and Ottenbacher et al.,(2006).
40	Use of proven technology	RESO	+	+	+		*		Cooper (1993), (2001) and (2005), Krishnan and Ulrich (2001), Mallon (2002) Herzberg (2006) and Ottenbacher et al. (2006)
41	Equipment age/ proper tools	RESO					-	+	Mallon (2002) and Pilbeam (2002)
42	Dependence on external resources	RESO						-	Pilbeam (2002)
43	Time-bound resources	RESO					-	-	Mallon (2002) and Pilbeam (2002)
44	Dedicated project leader ( one proj. at a time)	RESO		+			*		Cooper (1993) and (2001), Jawad (1995), Krishnan and Ulrich (2001), Ernst (2002) Herzberg (2006), Jimez-Jimez, et al. (2008).
45	Lack of funding	RESO		-				-	Ernst (2002) and Pilbeam (2002)
46	Independence from government	RESO						+	Pilbeam (2002)
47	Involvement of local/national government.	RESO						-	Pilbeam (2002)
48	Availability of resources, Raw Materials	RESO	+						Merrifield (1981), Carter (1982) and Balachandra & Friar (1997).
49	Human resources available	RESO			+	*			Mallon (2002) and Ottenbacher et al. (2006).
50	In-house product testing	RESO		*					Ernst (2002)
51	Data availability	RESO					*		Mallon (2002)
52	Data validity	RESO					*		Mallon (2002)

## Literature Review

Factor	Sub. Cat.	Private					Academic research	Reference
		R&D	NPD	NSD	MTA	ITA		
<b>Collaboration</b>								
53	Multi-organizational	COLL					*	Pilbeam (2002)
54	International aspects	COLL					+	Pilbeam (2002)
55	Reputation	COLL			+			Ottenbacher et al. (2006).
56	Collaboration/ networks	COLL					+	Pilbeam (2002)
57	Isolated institution	COLL					-	Pilbeam (2002)
<b>Clear business objectives</b>								
58	Effects on other business	BUSS	+				+	Carter (1982), Balachandra & Friar (1997) and Pilbeam (2002).
59	Clear vision	BUSS			+	+		Mallon (2002) and Ottenbacher et al. (2006).
60	Relation to other projects	BUSS		+				Cooper (1993) and (2001) and Ottenbacher et al. (2006).
61	Clarity of business objectives	BUSS					+	Jawad (1995)
62	Technology tied to business strategy	BUSS		+			+	Souder (1987), Balachandra & Friar (1997), Cooper (2001) and Pilbeam (2002).
63	Organisation plans	BUSS	+					Carter (1982) and Balachandra & Friar (1997)
64	Knowledge of procedures	BUSS					*	Ottenbacher et al. (2006).
<b>Leadership</b>								
65	Project manager as project champion	LEAD	+			+	*	Rothwell et al. (1974), Cooper (1993), (2001) and (2005), Cooper and Kleinschmidt (1996) Balachandra and Friar (1997), Ernst (2002), Goffin and Mitchell (2005), Ottenbacher et al. (2006) and Stendahl (2009)
66	Top management support	LEAD	+	+		*		Rothwell et al. (1974), Carter (1982), Cooper (1993), (2001) and (2005), Cooper and Kleinschmidt (1996) Balachandra and Friar (1997), Ernst (2002), Mallon (2002), Goffin and Mitchell (2005), Ottenbacher et al. (2006) and Stendahl (2009)
67	Effectiveness of project manager	LEAD	+				*	Rothwell et al. (1974), Cooper (1993), (2001) and (2005), Jawad (1995) Cooper and Kleinschmidt (1996) Balachandra and Friar (1997), Ernst (2002), Goffin and Mitchell (2005), Ottenbacher et al. (2006) and Stendahl (2009)
68	Technical background of managers	LEAD		+				Cooper (2001) and Ernst (2002)
<b>Management</b>								
69	Control	MNGT			*	-		Mallon (2002) and Ottenbacher et al. (2006)
70	Flexibility of general regulations	MNGT					*	Jawad (1995)
71	Team autonomy	MNGT		+	+		+	Brown and Eisenhardt (1995) Cooper and Kleinschmidt (1995), Balbontin et al. (1999), Cooper (2001), Ernst (2002), Pilbeam (2002), Ottenbacher et al. (2006) Goffin and Mitchell (2005) and Harmancioglu. et al. (2007)
72	Incentives (empowerment, responsibility, higher status)	MNGT		+	+			Brown and Eisenhardt (1995) Cooper and Kleinschmidt (1995), Balbontin et al. (1999), Cooper (2001), Ernst (2002) Pilbeam (2002), Ottenbacher et al. (2006) Goffin and Mitchell (2005) and Harmancioglu. et al. (2007)
73	Organisational structure	MNGT		+	+	*	*	Rubenstein et al. (1976), Allen (1977), Booz et al. (1982), Souder (1987), Jawad (1995), Balachandra and Friar (1997), Ernst (2002), Mallon (2002) and Goffin and Mitchell (2005)
74	Management and other skills	MNGT	+	+	+		+	Larson and Gobeli (1989), and Brown and Eisenhardt (1995), Pilbeam (2002) and Ottenbacher et al. (2006)

## Effects of R&D Implementation on the Performance of Publicly Funded Research in SQU

Factor	Sub. Cat.	Private					Academic research	Reference
		R&D	NPD	NSD	MTA	ITA		
75	No control over subject/idea	MNGT					-	Pilbeam (2002)
76	Monitoring and feedback	MNGT	+		+	*	+	Rothwell et al. (1974), Rubenstein et al. (1976), Cooper (1981), Pinto and Slevin (1987), Merrifield (1988), Cooper (2001) and (2008), Mallon (2002), Pilbeam (2002), Ottenbacher et al. (2006) and Harmancioglu (2007)
77	Structured project management	MNGT		+		*		Rubenstein et al. (1976), Allen (1977), Booz et al. (1982), Souder (1987), Balachandra and Friar (1997), Ernst (2002), Mallon (2002) and Goffin and Mitchell (2005)
78	Efficient decisions	MNGT		+	+		-	Brown and Eisenhardt (1995) Ernst (2002) and Pilbeam (2002)
79	Bureaucracy	MNGT					-	Pilbeam (2002)
80	Strategic human resource management	MNGT			+			Ottenbacher et al. (2006)
81	System procedures/ process	MNGT		+	+	*		Rothwell et al. (1974), Rubenstein et al. (1976), Cooper (1981), Pinto and Slevin (1987), Merrifield (1988), Cooper (2001) and (2008), Mallon (2002), Ottenbacher et al. (2006) and Harmancioglu (2007)
82	Top management commitment	MNGT	+	+		*		Rothwell et al. (1974), Carter (1982), Cooper (1993), (2001) and (2005), Cooper and Kleinschmidt (1996) Balachandra and Friar (1997), Ernst (2002), Mallon (2002), Goffin and Mitchell (2005), Ottenbacher et al. (2006) and Stendahl (2009)
83	Top management technical awareness	MNGT						Jawad (1995)
84	Performance assessment programmes	MNGT		+				Cooper (2001)
<b>Communication</b>								
85	Outside communication	COMM		*		*	+	Rubenstein et al. (1976), Allen (1977), Booz et al. (1982), Craig and Hart (1992), Souder (1987), Balachandra and Friar (1997), Ernst (2002), Mallon (2002), Pilbeam (2002) and Goffin and Mitchell (2005)
86	Format of information	COMM						Mallon (2002)
87	Internal Communication	COMM	+	+		*		Rubenstein et al. (1976), Allen (1977), Booz et al. (1982), Craig and Hart (1992), Souder (1987), Balachandra and Friar (1997), Ernst (2002), Mallon (2002) and Goffin and Mitchell (2005)
88	Clear communication demands and responsibilities	COMM		+			+	Rubenstein et al. (1976), Allen (1977), Booz et al. (1982), Craig and Hart (1992), Souder (1987), Balachandra and Friar (1997), Ernst (2002), Mallon (2002), Pilbeam (2002) and Goffin and Mitchell (2005)
89	No clear communication requirements	COMM					-	Pilbeam (2002)
<b>Process</b>								
90	Supplier analysis & selection	PROC				+	*	Jawad (1995) and Mallon (2002)
91	Narrow down suppliers	PROC				+		Jawad (1995)
92	Well-defined target market/end-users	PROC	*	+	+		+	Cooper (1981), Balachandra and Friar (1997), Pilbeam (2002), Ottenbacher (2006), Herzberg (2006), Jimez-Jimez, et al. (2008), Henard and Dacin (2010) and Buganza et al. (2010)

## Literature Review

Factor	Sub. Cat.	Private					Academic research	Reference
		R&D	NPD	NSD	MTA	ITA		
93	Market Analysis	PROC	*	+	+			Cooper (1981) and (2001), Balachandra and Friar (1997), Ottenbacher (2006), Herzberg (2006), Jimez-Jimez, et al. (2008), Henard and Dacin (2010) and Buganza et al. (2010)
94	Understanding market	PROC	*	+	+			Cooper (1981) and (2001), Balachandra and Friar (1997), Ottenbacher (2006), Herzberg (2006), Jimez-Jimez, et al. (2008), Henard and Dacin (2010) and Buganza et al. (2010)
96	Accurate market forecasts	PROC		+				Cooper (1993) and (2001) and Ernst (2002)
97	Proficiency of marketing	PROC		+	+			Cooper (1981) and (2001), Balachandra and Friar (1997), Ottenbacher (2006), Herzberg (2006), Jimez-Jimez, et al. (2008), Henard and Dacin (2010) and Buganza et al. (2010)
98	Develop and implement market strategy	PROC		+	+			Cooper (1981) and (2001), Balachandra and Friar (1997), Ottenbacher (2006), Herzberg (2006), Jimez-Jimez, et al. (2008), Henard and Dacin (2010) and Buganza et al. (2010)
99	Market launch	PROC		+	+			Cooper (1981) and (2001), Balachandra and Friar (1997), Ottenbacher (2006), Herzberg (2006), Jimez-Jimez, et al. (2008), Henard and Dacin (2010) and Buganza et al. (2010)
100	Test marketing-trial sell	PROC		+	+			Cooper (1981) and (2001), Balachandra and Friar (1997), Ottenbacher (2006), Herzberg (2006), Jimez-Jimez, et al. (2008), Henard and Dacin (2010) and Buganza et al. (2010)
101	Understanding buyer behaviour	PROC		+	+			Cooper (1993), (2001) and (2005), Balachandra and Friar (1997), Krishnan and Ulrich (2001), Goffin and Mitchell (2005), Ottenbacher et al. (2006), Johnson and Luo (2008), Johnson et al. (2009), Henard and Dacin (2010) and Buganza et al. (2010).
102	Correct Distribution channels	PROC		+				Cooper (1993) and (2001)
103	Create, Make, Market interface	PROC	+	+				Rubenstein et al. (1976), Maidique and Zirger (1984) and Balachandra and Friar (1997)
104	Sufficient Development	PROC				-		Mallon (2002)
105	Documentation	PROC				*		Mallon (2002)
106	Emphasise marketing	PROC		+	+			Cooper (1981) and (2001), Balachandra and Friar (1997), Ottenbacher (2006), Herzberg (2006), Jimez-Jimez, et al. (2008), Henard and Dacin (2010) and Buganza et al. (2010)
107	Identify constraints	PROC				+		Mallon (2002)
108	Sufficient evaluation and Initial screening	PROC		+	+	-		Cooper (2001), Mallon (2002) and Ottenbacher (2006)
109	Provision of user training	PROC			+		+	Jawad (1995) and Ottenbacher (2006)
110	Piloting the project	PROC		+	+	+	*	Jawad (1995), Mallon (2002) and Ottenbacher (2006)
111	Preliminary technical assessment	PROC		+				Cooper (1993), (2001) and (2005), Balachandra and Friar (1997), Krishnan and Ulrich (2001), Goffin and Mitchell (2005), Johnson and Luo (2008), Johnson et al. (2009), Henard and Dacin (2010) and Buganza et al. (2010).
112	Meeting Cost schedules	PROC	+	+				Balachandra and Friar (1997) and Ernst (2002)
113	Slow build-up / ramp-up	PROC				+		Mallon (2002)



## Effects of R&D Implementation on the Performance of Publicly Funded Research in SQU

Factor	Sub. Cat.	Private					Academic research	Reference	
		R&D	NPD	NSD	MTA	ITA			
114	Statistical analysis	PROC				+		Mallon (2002)	
115	Background analysis	PROC				+		Mallon (2002)	
116	Consistency	PROC			+			Ottenbacher (2006)	
117	Error Free production	PROC		+				Rothwell et al. (1974) and Balachandra and Friar (1997)	
118	Intensity of customer involvement	PROC		+				Cooper (1993), (2001) and (2005), Balachandra and Friar (1997), Krishnan and Ulrich (2001), Goffin and Mitchell (2005), Ottenbacher et al. (2006), Johnson and Luo (2008), Johnson et al. (2009), Henard and Dacin (2010) and Buganza et al. (2010).	
119	User involvement	PROC	+				*	Cooper (1993), (2001) and (2005), Jawad (1995), Balachandra and Friar (1997), Krishnan and Ulrich (2001), Goffin and Mitchell (2005), Ottenbacher et al. (2006), Johnson and Luo (2008), Johnson et al. (2009), Henard and Dacin (2010) and Buganza et al. (2010).	
120	Competitor Analysis	PROC	+	+	+	+		SPRU (1972), Rothwell (1977), Cooper (1979), (1981) and (2001), Cooper and Kleinschmidt (1993), Carter (1982), Balachandra and Friar (1997), Mallon (2002) and Ottenbacher et al. (2006)	
121	Early analysis of market & profit	PROC		-	+			Maidique and Zirger (1984), Balachandra and Friar (1997) and Ottenbacher et al. (2006)	
<b>Team</b>									
<b>Team Composition</b>									
122	Know people involved	COMP				+		+	Mallon (2002) and Pilbeam (2002)
123	Team from begin to end no hands off	COMP	+	+					Cooper (1993) and (2001), Cooper and Kleinschmidt (1996), Ernst (2002) and Goffin and Mitchell (2005)
124	Cross functional teams / integrated	COMP	+	+		+			Maidique and Zirger (1984), Cooper (1984) and (2001), Larson (1988), Craig and Hart (1992), Brown and Eisenhardt (1995), Mallon (2002), Goffin and Mitchell (2005), Ottenbacher et al. (2006), Swink & Song (2007), Harmancioglu (2007) and Stendahl (2009)
125	Team composition/size	COMP			+	*		+	Mallon (2002), Pilbeam (2002) and Ottenbacher et al. (2006)
126	Team cohesion	COMP				-		+	Mallon (2002) and Pilbeam (2002)
127	Team balance	COMP				+			Mallon (2002)
128	Teamwork	COMP						+	Pilbeam (2002)
129	Implementers	COMP		+	+	+			Goffin and Mitchell (2005) and Ottenbacher et al. (2006)
130	Groupism	COMP						-	Pilbeam (2002)
<b>Motive</b>									
131	Existence of Ownership	MOTV						+	Pilbeam (2002)
132	Lack of ownership	MOTV						-	Pilbeam (2002)
133	Level of conviction / commitment	MOTV	+		+	*			Pinto and Slevin (1987), Brown and Eisenhardt (1995), Balachandra and Friar (1997), Mallon (2002) and Ottenbacher et al. (2006)
134	Potential interest of technical staff	MOTV	+					+	Carter (1982), Balachandra & Friar (1997) and Pilbeam (2002)
135	Drive / motivation/ Enthusiasm	MOTV				*		+	Mallon (2002) and Pilbeam (2002)
136	Peripheral activity	MOTV						-	Pilbeam (2002)

## Literature Review

Factor	Sub. Cat.	Private					Academic research	Reference
		R&D	NPD	NSD	MTA	ITA		
137	Interesting/fun	MOTV					+	Pilbeam (2002)
138	Hard work / long hours	MOTV				+		Mallon (2002)
139	Imposed idea	MOTV					-	Pilbeam (2002)
<b>Skills</b>								
140	Negotiation skills	SKIL				+		Mallon (2002)
141	Qualified/ skilled project manager	SKIL	+			+		Balachandra & Friar (1997), Cooper (2001), Ernst (2002) and Mallon (2002)
142	Staff technical capabilities	SKIL			+	*	*	Jawad (1995), Mallon (2002), Ottenbacher et al. (2006)
143	Staff of professionals/ High quality staff	SKIL	+	+			+	Larson (1988), Craig and Hart (1992), Brown and Eisenhardt (1995), Cooper (2001), Mallon (2002), Pilbeam (2002), Goffin and Mitchell (2005), Ottenbacher et al. (2006), Swink & Song (2007), Harmancioglu (2007) and Stendahl (2009)
144	Low quality staff	SKIL					-	Pilbeam (2002)
145	Training	SKIL		+	+	*		Baker et al. (1986), Balachandra & Friar (1997) Mallon (2002) and Ottenbacher et al. (2006)
146	Experience of own people	SKIL	+			*		Baker et al. (1986), Balachandra & Friar (1997) and Ottenbacher et al. (2006)
147	Team communication	SKIL	+	+			+	Rothwell et al. (1974), Rubenstein et al. (1976), Allen (1977), Souder and Chakrabarti (1978), Booz et al. (1982), Souder (1987), Craig and Hart (1992), Balachandra et al. (1996), Balachandra and Friar (1997), Cooper (2001), Ernst (2002), Mallon (2002), Pilbeam (2002) and Goffin and Mitchell (2005)
148	Markets and technologies are strengths	SKIL		+				Pinto and Slevin (1987), Brown and Eisenhardt (1995) and Balachandra and Friar (1997)
149	Strong Sales force	SKIL		+				Balachandra and Friar (1997) and Cooper (2001)
150	Use of project management methods	SKIL					+	Jawad (1995)
151	Understand technologies / science	SKIL				+		Mallon (2002)
152	Trouble shooting	SKIL	+		+			Pinto and Slevin (1987), Balachandra and Friar (1997) and Ottenbacher et al. (2006)
95	Technical resources/tools and skills	SKIL		+			+	Cooper (2001), Ernst (2002) and Pilbeam (2002)
153	Indigenous R & D capabilities/skills	SKIL	+		+		+	Brown and Eisenhardt (1995), Jawad (1995) and Ottenbacher et al. (2006)
154	Previous experience	SKIL					*	Jawad (1995)
<b>Project</b>								
<b>Source of Idea</b>								
155	Source of project ideas	IDEA		+	*		+	Cooper (2001), Pilbeam (2002) and Ottenbacher et al. (2006)
156	Involve employee	IDEA		+	+			Cooper (2001) and Ottenbacher et al. (2006)
157	Need	IDEA		+	+	+		Cooper (1981) and (2001), Maidique and Zirger (1984), Balachandra and Friar (1997), Ernst (2002), Goffin and Mitchell (2005), Ottenbacher et al. (2006) and Henard and Dacin (2010).

## Effects of R&D Implementation on the Performance of Publicly Funded Research in SQU

	Factor	Sub. Cat.	Private					Academic research	Reference
			R&D	NPD	NSD	MTA	ITA		
159	Work context idea	IDEA						+	Pilbeam (2002)
	<b>End-user</b>								
160	Perceived value	USER		+					Cooper (1981) and (2001), Maidique and Zirger (1984), Balachandra and Friar (1997), Ernst (2002), Goffin and Mitchell (2005) and Henard and Dacin (2010).
161	Number of end uses	USER	*						Balachandra and Raelin (1984) and Balachandra & Friar (1997).
162	User maturity	USER						*	Mallon (2002)
163	Customers' price sensitivity	USER		*					Ernst (2002) and Goffin and Mitchell (2005)
164	Customers' needs, wants	USER	*	+	+	*			Cooper (1981) and (2001), Maidique and Zirger (1984), Balachandra and Friar (1997), Ernst (2002), Mallon (2002), Goffin and Mitchell (2005), Ottenbacher et al. (2006) and Henard and Dacin (2010).
165	Characteristics of customers involved: high economic attractiveness/lead-user	USER		*					Ernst (2002)
166	User acceptance	USER	+		+			+	Pinto and Slevin (1987), Jawad (1995), Balachandra and Friar (1997), Cooper (2001), Ernst (2002), Mallon (2002), Goffin and Mitchell (2005), Ottenbacher et al. (2006) and Henard and Dacin (2010).
	<b>Nature</b>								
167	Demand pull vs. Tech push	NATR	*	*				+	Rubenstein et al. (1976), Allen (1977), Booz et al. (1982), Souder (1987), Balachandra and Friar (1997), Ernst (2002), Pilbeam (2002) and Goffin and Mitchell (2005)
168	Technology Route	NATR	+						Pinto and Slevin (1987) and Balachandra and Friar (1997)
169	Newness to firm	NATR		*					Cooper (1981) and (2001)
170	Multidisciplinary	NATR						*	Pilbeam (2002)
	<b>Clear Goals</b>								
171	Preventative Maintenance Programme	GOAL					+		Mallon (2002)
172	Poor Design	GOAL					*	-	Mallon (2002) and Pilbeam (2002)
173	Specification	GOAL					*		Mallon (2002)
174	Directions for scientific development	GOAL	+						Carter (1982) and Balachandra & Friar (1997)
175	Poor method	GOAL						-	Pilbeam (2002)
176	No agreement of method	GOAL						-	Pilbeam (2002)
177	Defined method	GOAL						+	Pilbeam (2002)
178	Define functionality	GOAL					*		Mallon (2002)
179	Project mission	GOAL	+		*				Pinto and Slevin (1987), Balachandra and Friar (1997) and Ottenbacher et al. (2006)
180	Quantitative project selection	GOAL		+					Merrifield (1981), Balachandra & Friar (1997), Griffin and Page (1996) and Cooper (2001).

## Literature Review

Factor	Sub. Cat.	Private					Academic research	Reference	
		R&D	NPD	NSD	MTA	ITA			
181	Product definition	GOAL		+				Rubenstein et al. (1976), Souder (1987), Cooper (1985), (1993), (2001) and (2005), Cooper and Kleinschmidt (1996), Griffin and Page (1996), Goldenberg et al. (2001), Ottenbacher et al. (2006) Goffin and Mitchell (2005) and Henard and Dacin (2010).	
182	Existence of product strategy	GOAL		+	+	-	+	+	Cooper (1985), (1993), (2001) and (2005), Jawad (1995), Cooper and Kleinschmidt (1996), Griffin and Page (1996), Ottenbacher et al. (2006), Goldenberg et al. (2001), Pilbeam (2002), Mallon (2002), Goffin and Mitchell (2005) and Henard and Dacin (2010).
183	Clearly defined Realistic objectives	GOAL		+		*	+	+	Cooper (1985), (1993), (2001) and (2005), Jawad (1995), Cooper and Kleinschmidt (1996), Griffin and Page (1996), Ottenbacher et al. (2006), Goldenberg et al. (2001), Pilbeam (2002), Mallon (2002), Goffin and Mitchell (2005) and Henard and Dacin (2010).
184	Obscure objectives	GOAL						-	Pilbeam (2002)
185	Considering hidden costs	GOAL					+		Mallon (2002)
186	Problem Definition	GOAL	*	+				+	Pilbeam (2002)
187	Objectives understood	GOAL			+	*			Rubenstein et al. (1976), Souder (1987), Cooper (1985), (1993), (2001) and (2005), Cooper and Kleinschmidt (1996), Griffin and Page (1996), Goldenberg et al. (2001), Ottenbacher et al. (2006), Goffin and Mitchell (2005) and Henard and Dacin (2010).
<b>Planning</b>									
188	Project schedule/planning	PLAN	+	+		*		+	Pinto and Slevin (1987), Balachandra and Friar (1997), Cooper (2001), Mallon (2002) Pilbeam (2002)
189	Poor planning	PLAN						-	Pilbeam (2002)
190	R&D process well planned	PLAN	+	+					Rubenstein et al. (1976), Baker et al. (1986), Balachandra and Raelin (1984) and Balachandra & Friar (1997).
191	Timing	PLAN	+	+				+	Hopkins (1981), Carter (1982), Balachandra & Friar (1997) and Pilbeam (2002)
192	Inadequate time allocation	PLAN						-	Pilbeam (2002)
193	Sufficient time	PLAN					-	*	Jawad (1995), Mallon (2002) and Pilbeam (2002)
194	On-going production not affected	PLAN					+		Mallon (2002)
195	production start up time	PLAN		*					Rubenstein et al. (1976), Carter (1982) and Balachandra & Friar (1997).
<b>Result</b>									
196	Fit for purpose / application	RSLT						-	Mallon (2002)
197	Incremental product	RSLT		+	+				Cooper (1985), (1993), (2001) and (2005), Cooper and Kleinschmidt (1996), Griffin and Page (1996), Goldenberg et al. (2001), Goffin and Mitchell (2005), Ottenbacher et al. (2006), and Henard and Dacin (2010).
198	Innovative product	RSLT		+	+				Cooper (1985), (1993), (2001) and (2005), Cooper and Kleinschmidt (1996), Griffin and Page (1996), Goldenberg et al. (2001), Goffin and Mitchell (2005), Ottenbacher et al. (2006), and Henard and Dacin (2010).
199	High Performance to Cost	RSLT	*	+					Maidique and Zirger (1984), Balachandra and Friar (1997) and Ernst (2002)

**Effects of R&D Implementation on the Performance of Publicly Funded Research in SQU**

	Factor	Sub. Cat.	Private					Academic research	Reference
			R&D	NPD	NSD	MTA	ITA		
200	Utility	RSLT	+					Carter (1982) and Balachandra & Friar (1997).	
201	Impact	RSLT					+	Pilbeam (2002)	
202	Non-delivery	RSLT					-	Pilbeam (2002)	
203	Life Cycle	RSLT	*	+				Balachandra & Friar (1997) and Cooper (2001)	
204	Reliability	RSLT				-		Mallon (2002)	
205	Ease of re-set	RSLT				-		Mallon (2002) Balachnadra and Raelin (1984)	
206	Upgradable/ Enhance-ability	RSLT				+	+	Jawad (1995) and Mallon (2002)	
209	Complexity	RSLT				-		Mallon (2002)	
210	Ease of use	RSLT					+	Jawad (1995)	
211	Set-up time	RSLT				-		Mallon (2002)	
212	Ease of maintenance	RSLT				-		Mallon (2002)	
213	Open system interconnection	RSLT					*	Jawad (1995)	
214	Product advantages; benefits to customer	RSLT		+	+			Cooper (1993), (2001) and (2005), Cooper and Kleinschmidt (1996), Goffin and Mitchell (2005), Ottenbacher et al. (2006), and Henard and Dacin (2010).	
215	Product Liability	RSLT	-					Carter (1982) and Balachandra & Friar (1997).	
216	High Contribution Margin	RSLT	+	+				Rubenstein et al. (1976), Baker et al. (1986) and Balachandra & Friar (1997).	
217	Products aimed at a few customers	RSLT		-				Cooper (2001)	
218	Lower Cost	RSLT	+	+	+			Cooper (1993), (2001) and (2005), Cooper and Kleinschmidt (1996), Griffin and Page (1996), Goffin and Mitchell (2005) and Ottenbacher et al. (2006).	
219	Probability of commercial success	RSLT	+			-		Balachnadra and Raelin (1984), Cooper (1993), (2001) and (2005), Cooper and Kleinschmidt (1996), Griffin and Page (1996), Balachandra & Friar (1997), Mallon (2002) and Goffin and Mitchell (2005)	
220	Inexpensive development	RSLT		+				Balachandra & Friar (1997)	
221	Probability of technical success	RSLT	+					Carter (1982), Balachnadra and Raelin (1984) and Cooper (1993), (2001) and (2005).	

Table 3.1: List of factors compiled from the literature review of R&D and innovation fields. R&D refers to research and development, NPD refers to new product development, NSD means new service development MTA is manufacturing technology acquisition and ITA refers to information technology acquisition.

### 3.4.1 R&D strategy

Scott (1978) shed light on the historical development of strategic management. Before the 1960s, management theories tended not to be concerned with the environment, competition, the marketplace or anything else external to the organisation. Since 1960 theorists of the conventional strategic management school began to take external factors into account. The main core of this school is strategic fit, i.e. matching companies' strengths and weaknesses with environmental threats and opportunities. The core element of the conventional strategic management school is that

*“The cause for success or failure of an organisation lies ultimately on its environment” (Steenhuis, 2005, p 130)*

Without going into the debate within strategy formation theories such as rationality, implement-ability, sequence (Moore, 2000), behavioural and political approaches (Dufour and Steane, 2007); strategy here is taken to be the means used by an organisation to reach certain points (Thompson, 1995). Bowman and Asch (1987) and Bowman (1990) defined strategy as a process, from setting targets and objectives through to monitoring activities and achievement of the objectives. This approach implicitly included the need to answer three main questions; where are we now? where do we want to go? how will we get there? Faulkner and Bowman (1995) expanded these questions and added; where should we compete? what products should we compete with? how will we gain sustainable competitive advantage in these chosen markets?

R&D strategic framework provides R&D programmes with strategic focus. This gives an overall direction to individual R&D projects and influences their performance success (Cooper, 2001). It provides R&D managers with a guide to the contents of proposals, targeted markets and future innovation projections (Craig and Hart, 1992; Jawad, 1995; Balachandra and Friar, 1997; Cooper, 2001; Mallon, 2002; Pilbeam 2002; Goffin and Mitchell, 2005; Millson and Wilemon, 2008; Stendahl, 2009).

Development of innovation strategy requires three elements (Goffin and Mitchell, 2005). Firstly a strategic analysis is needed to understand organisation competencies, environment in which organisation operates and the goals and objectives of stakeholders. Secondly a strategic choice is required as a best selection from various options considering type of business, intended markets etc... Finally a strategic implementation framework is needed to consider resource requirement for implementation and organisational and management processes.

As can be seen from Table 3.1, many studies found that implementation environment influences R&D success. The uncertainty of environmental conditions poses challenges (Balachandra and Friar, 1997; Stendahl, 2009). R&D projects

*“cannot succeed if the environment is not supportive”  
(Balachandra and Friar, 1997, p 278).*

Skilled patent's attorney and suppliers (Jawad, 1995; Mallon, 2002), legal conditions (e.g. laws of intellectual property) and the perceptions of future political conditions (Carter, 1982) affect R&D performance. While public interests (Carter, 1982; Pilbeam, 2002) positively affect success, political and social involvement (Pilbeam, 2002) characterise less successful R&D projects, more successful projects are featured by a degree of independence.

Market strength is important factor for project success (SPRU, 1972; Rothwell, 1977; Cooper, 1979 and 1981; Cooper and Kleinschmidt, 1993; Carter, 1982; Balachandra and Friar, 1997; Ottenbacher et al., 2006). Cooper (2001) argued that products targeted at more attractive markets had 1.7 times higher success rate than products targeted at non-attractive markets. They rated much higher in terms of profitability and meeting sales and profit objectives. Market competition and number of competitors were of influence (Carter, 1982; Cooper, 1980, 2001 and 2005; De Brentani, 1991; Ernst, 2002; Stendahl, 2009) but found to have a lower impact than expected (Cooper, 2001). Products aimed at

competitive markets were only marginally more successful than those targeted at less competitive markets.

Further, the nature of the market competition and the number of competitors are influential factors (Carter, 1982; Cooper, 1980; De Brentani, 1991; Ernst, 2002). Competitive markets provide intense competition in terms of price and higher-quality. This factor was originally thought to affect success significantly, but was found to have a lower impact than expected. Products aimed at highly competitive markets were only marginally more successful than those targeted at less competitive markets (Cooper, 2001).

### 3.4.2 Organization

Some of the factors in (Table 3.1) overlap with the categories “**Team**” and/or “**Strategy**”. They belong to this category as they are related to procedure more than the strategy itself or the team implementing the activity.

Organisational culture is an important factor for successful NPD process (Rothwell et al., 1974; Balachandra and Friar, 1997; Ernst, 2002; Goffin and Mitchell, 2005; Ottenbacher et al., 2006; Stendahl, 2009). Successful innovations existed where innovators have more responsibility, power, enthusiasm and higher status as compared to their colleagues in less successful projects (Rothwell et al., 1974; Ernst, 2002). The culture of free time for scientists to actively search for ideas is characteristic of more successful firms (Cooper, 1984 and 2001; Ernst, 2002). An “innovation-friendly” and risk-taking climate provides an efficient environment for suggesting new products compared to company-based suggestion schemes. This positively influences the performance of R&D projects (Ernst, 2002).

The existence and the effect of “Product Champion” characterises the environment that enables success (Maidique and Zirger, 1984; Cooper and Kleinschmidt, 1993, 1995 and 1996; Ernst, 2002). A skilled “Product Champion” believes in the new idea and advances it through the organization with great personal commitment. A “Powerful Promoter” (from senior management) helps



individuals to overcome internal barriers and secures necessary resources for the project. Both “Product Champion” and “Power Promoter” influence success of R&D projects.

Organisational structures determine clear roles and responsibilities, and define proper communication channels (Rubenstein et al., 1976; Allen, 1977; Booz et al., 1982; Souder, 1987; Balachandra and Friar, 1997; Ernst 2002; Goffin and Mitchell, 2005). Clear communication features in successful projects (Allen, 1977; Craig and Hart, 1992; Pilbeam, 2002). Successful companies adopt integrative mechanisms, good communications systems and flat, or decentralized, systems of control (Craig and Hart, 1992; Brown and Eisenhardt, 1995). These requirements need to be flexible enough to facilitate smooth implementation of the project (Craig and Hart, 1992). Communication could be enhanced with the use of symbols (logos and slogans) and talented managers who reshape old stories and inspire future ones (Goffin and Mitchell, 2005). Allen (1977) and Pilbeam (2002) emphasised the importance of communication outside the organisation as well as within it.

Most of the R&D studies argued the importance of high-quality preparatory work on success (Balachandra and Friar, 1997; Cooper, 2001 and 2005; Krishnan and Ulrich, 2001; Goffin and Mitchell, 2005; Herzberg, 2006; Ottenbacher et al., 2006; Jimenez-Jimez, et al., 2008; Johnson and Luo, 2008; Buganza et al., 2010; Henard and Dacin, 2010). Predevelopment activities include: initial screening, preliminary market and technical assessment, detailed market study, and business or financial and commercial analysis (Cooper, 2001 and 2005). Product definition is likely to be weak and vague unless its predevelopment actions are carried out well. Success needs proper planning and initial selection decisions before commencement of the project (Griffin and Page, 1996; Cooper, 2001 and 2005; Goffin and Mitchell, 2005; Herzberg, 2006; Harmancioglu, 2007). Products with effective implementation of activities before the development phase (Cooper, 2001):

- rated a success of 75% as to 31.3% for projects that have poor execution of predevelopment activities,
- rated profitability of 7.2 out of 10, whereas projects with poor predevelopment activities scored only 3.7, and
- scored 45.7% market share compared to 20.8% for the other category

Market oriented NPD process is more successful compared to those with less market orientation (Cooper, 1981; Balachandra and Friar, 1997; Ottenbacher, 2006; Herzberg, 2006; Jimenez-Jimenez, et al., 2008; Buganza et al., 2010; Henard and Dacin, 2010). This refers to the quality of market research (“marketing synergy” in Cooper (2001)) to understand customer needs, accurate prediction of market potential and competition (Table 3.1). It links the demands for the project to firm's sales force, advertising and marketing resources and customer service capabilities. Projects with a positive marketing synergy (Cooper, 2001):

1. scored 2.3 times greater than products lacking it, in terms of success
2. hit a profit of 6.6 out of 10 versus 3.7, and
3. scored a market share of 14 points higher than products with negative marketing synergy.

Successful projects feature a strong fit between the technical needs of the project and the firm's resources and skills (Cooper (2001) called it “technological synergy”). Market synergy includes; preliminary market assessment; detailed market study or marketing research; customer tests of the product prototype or sample; the trial sell or test market; and the market launch itself. Technical synergy includes the engineering and production skills and resources needed to accomplish the mission. Carter (1982) summarised it as:

*“Both the difficulty of the technical problem and the competence of the organisation to solve the problem need to be considered”. (Carter, 1982, p 27)*

Success needs both (market and technical) synergies (Cooper and Kleinschmidt, 1993; Balachandra and Friar, 1997; Cooper, 2001 and 2005; Krishnan and Ulrich, 2001; Goffin and Mitchell, 2005; Herzberg, 2006;

Ottenbacher et al., 2006; Jimez-Jimez, et al., 2008; Johnson and Luo, 2008; Buganza et al., 2010; Henard and Dacin, 2010). The quality implementations of these activities attained success rate of 2.2 times higher than poor implementations and scored a market share of 18.5 points (Cooper, 2001).

Cooper (2001) argued that projects supported by top managers fail and succeed with almost the same frequency. This contradicts the findings of SPRU, (1972), Jawad, (1995), Brown and Eisenhardt (1995), Balachandra and Friar (1997), Ernst (2002), Mallon (2002) and Pilbeam (2002). Committed and involved senior management provides considerable guidance and direction for projects and make strategic decisions for resource allocation. Management decisions influence the support for the NPD particularly in conflict with the existing core business (Ernst, 2002). Furthermore, proper monitoring and feedback process increase the chance of success (Rothwell et al., 1974; Rubenstein et al., 1976; Cooper, 1981, Pinto and Slevin, 1987, Merrifield, 1988, Jawad, 1995, Cooper, 2001 and 2008; Mallon, 2002; Pilbeam, 2002; Harmancioglu, 2007). A style of closer management characterises successful projects as compared to bureaucratic management that lacks control over the topic or idea in less successful projects (Pilbeam, 2002). Continuous monitoring of implementation processes generates inputs for decisions made as to terminate (or not) a project at certain milestones (Griffin and Page, 1996; Cooper, 2001 and 2008; Harmancioglu, 2007).

### **3.4.3 Team**

Table 3.1 shows that many studies investigated the role of the team implementing R&D projects in the success of these projects. Balance between the level of cross-functional involvement and the degree of space is needed (Gupta et al., 1986). A cross-functional team composition:

*“can generate really good ideas and prevent implementation problems”. (Goffin and Mitchell, 2005, p 282)*

It facilitates functional coordination and assists overcoming organizational interface challenges, reduces implementation time and increases cost savings because problems are detected much earlier in implementation processes (Cooper, 1984 and 2001; Maidique and Zirger, 1984; Larson, 1988; Craig and Hart, 1992; Brown and Eisenhardt, 1995; Mallon, 2002; Goffin and Mitchell, 2005; Ottenbacher et al., 2006; Harmancioglu, 2007; Swink and Song, 2007; Stendahl, 2009). Functional coordination contributes to successful NPD (Maidique and Zirger, 1984; Pinto and Pinto, 1990). It also integrates R&D and NPD portfolios and reduces development cycle time (Cooper, 1984 and 2001; Larson, 1988). An effective team composition includes members from R&D, Marketing and Production (Craig and Hart, 1992; Cooper, 2001; Goffin and Mitchell, 2005). However, preservation of degree of space assists completion of separated activities (Moeneart and Souder, 1990; Rothwell and Whiston, 1990).

Goffin and Mitchell (2005) presented five levels of cross-functional structures; functional team, cross-functional teams; heavyweight cross-functional teams, autonomous teams and virtual teams. Each level of integration has advantages and limitations. Gupta et al., (1986) provided a model to decide on the level of functional integration. It considers organizational strategy, environmental uncertainty, organizational and individual factors. The proper level of integration depends on the individual project (Ernst, 2002; Goffin and Mitchell, 2005). When time to market is of central importance, for example, a task force model is superior. For other work, see Larson and Gobeli (1988) both matrix and task force models are suitable.

The R&D team should bear the responsibility for the entire project in order to maintain their motivation and commitment (Cooper and Kleinschmidt, 1993 and 1996; Ernst 2002). The team needs a degree of autonomy as it enhances their motivation and forms a feature of successful project (Ernst, 2002; Pilbeam, 2002). Further, transparent link between goals and rewards and recognitions, enhances team motivation to achieve a project's goals and acquire new skills (Goffin and Mitchell, 2005).

Many works, as can be seen from Table 3.1, argued the importance of project leadership. Technical and managerial qualification and skills are important (Larson and Gobeli, 1989; Brown and Eisenhardt, 1995). The latter is closely related to effective leadership of individuals from various areas of expertise as well as making the necessary delegation of decision-making (Brown and Eisenhardt, 1995; Ernst, 2002). Project leader needs dedication and empowerment (Cooper and Kleinschmidt 1995; Cooper, 2001; Goffin and Mitchell, 2005; Harmancioglu. et al., 2007) necessary qualifications (Balbontin et al. 1999) and sufficient authority (Brown and Eisenhardt, 1995; Ernst, 2002) to accomplish a successful project. Intensive communication (e.g. sharing of information) and interactive relationships within the team (e.g. project meetings) influence success of R&D projects (Rothwell et al., 1974; Souder and Chakrabarti, 1978; Balachandra et al., 1996; Pilbeam, 2002). Communication differs from coordination as it takes place not only between team members with different functions but also between members with the same function. Further, Cooper (2001) argued that the team has to be physically close to enhance the communication process.

#### **3.4.4 Task or project**

There seem to be an agreement among authors about the positive influence of product strategy (construct) on project success (Cooper, 1985, 2001 and 2005; Cooper and Kleinschmidt, 1993 and 1996; Jawad, 1995; Griffin and Page, 1996; Goldenberg et al., 2001; Pilbeam, 2002; Mallon, 2002; Goffin and Mitchell, 2005; Henard and Dacin, 2010). It focuses on the project's goals or objectives, the contribution of new products in achieving company goals and strategic fit into overall firm's strategic areas (Cooper and Kleinschmidt, 1996; Cooper, 2001) and aims to satisfy end users (Goffin and Mitchell, 2005). Product strategy that defines a set of related products (e.g. similar end-users) that fit well into the firm's line of current production has a strong potential for success (Cooper, 1985 and 2001).

The source of an idea is important for success (Cooper, 2001; Pilbeam, 2002; Goffin and Mitchell, 2005; Ottenbacher et al., 2006). Work by Rubenstein et al. (1976) and Balachandra and Friar (1997) argued that the nature of a project (demand pull vs. technology push) is of importance but they did not indicate what influence (positive or negative) it has on success. Cooper (1979) argued that technology-push and market-pull products stand equally the same chance of success. In contrast, Myers and Marquis (1969) emphasized that market-pull products are more likely to succeed. Pilbeam (2002) however, found that technology-push has a positive influence on success when projects deliver novel applications. These findings call for effective coordination processes between technology and marketing functions in order to bridge technology-push and market-pull perspectives (see Cooper, 1980; Hopkins, 1981; Carter, 1982; Goldenberg et al., 2001).

Involvement of end users in idea generation assists with knowing their needs and requirements. It brings in knowledge about user environments and enhances speed to market and product performance (Cooper, 2001 and 2005; Balachandra and Friar, 1997; Krishnan and Ulrich, 2001; Goffin and Mitchell, 2005; Ottenbacher et al., 2006; Johnson and Luo, 2008; Johnson et al., 2009; Buganza et al., 2010; Henard and Dacin, 2010). Further efforts are needed to analyse customers "hidden needs" or "perceived value" of intended products (Cooper, 1981 and 2001; Maidique and Zirger, 1984; Balachandra and Friar, 1997; Ernst, 2002; Goffin and Mitchell, 2005; Henard and Dacin, 2010). Clarks Shoes conducted contextual interviews with customers in 2002 (walkers) to understand their habits, wants and expectations. Some features are quickly identified such as "Comfort", "Fit" and "Safety". Contextual interviews allowed the team to understand the underlying meanings of these terms and work to satisfy them (Goffin and Mitchell, 2005).

It is clear from Table 3.1 that clear objectives and proper planning of the undertaken R&D activities influence the success of projects (Souder, 1987; Cooper, 1993, 2001 and 2005; Balachandra and Friar, 1997; Krishnan and Ulrich, 2001; Goffin and Mitchell, 2005; Ottenbacher et al., 2006; Johnson and

Luo, 2008; Buganza et al., 2010; Henard and Dacin, 2010). Pilbeam (2002) further indicated that successful projects possess the characteristic of having a defined method to tackle a defined problem. Problem definitions include targeted market, customer needs and wants, and product's specifications and requirements as compared to loser products (Cooper, 2001). Cooper found that well-defined projects:

- were 3.3 times as likely to be successful,
- had on average 38 points market share,
- rated 7.6 versus 3.1 for poorly defined products, in terms of profitability on a 10 points scale, and
- better met company sales and profit objectives.

Product liability has a negative influence on overall product success while product utility positively influences it (Carter, 1982). Products that better meet customer needs, are of higher quality, solve a problem with a competitive product, reduce customer's total costs and are introduced first time in the market are more successful (Cooper, 2001; Goffin and Mitchell, 2005; Henard and Dacin, 2010). Further, products that deliver unique advantages to users are more successful, "superior", than products that follow previous leads ("me-too" products in Cooper (2001)), when compared to similar competitive products (Cooper, 2001). High-advantage products scored 98.0% user acceptance compared to 18.4% for low-advantage products. They took a 53.5% market share and 8.4 (out of 10) profits. In contrast, low-advantage products attained only an 11.6% market share and 2.6 profits (Cooper, 2001).

### **3.5 MODELS OF R&D IMPLEMENTATION**

There have been several attempts to model the processes of R&D implementation. Some of these attempts are linear relationships while others are non-linear.

### 3.5.1 Linear models

Cooper's "NewProd" work is influential and frequently cited (Ernst, 2002). Cooper assumed that effective and efficiently designed implementation processes would strongly impact new product performance (Cooper, 2001). Based on this assumption, he developed a "**Stage-Gate**" model. It breaks the process of implementation into a predetermined set of stages. Each stage consists of a set of prescribed activities:

- Stage one: is a preliminary investigation and scoping of the project.
- Stage two: is a detailed investigation leading to a business case. This includes market research, user needs evaluation, technical and manufacturing assessment and financial and business analysis.
- Stage three: is the development phase which includes detailed design, prototype development, first in-house testing and limited customer testing.
- Stage four: is the testing and validation phase where extensive in-house testing, field trials, pilot, preproduction and sale trials take place.
- Stage five: is the full production and market launch phase.

The beginning of each stage is defined by a gate that controls the process and serves as quality check point, see Figure 3.2. Gates define input, determine criteria for evaluation and define outputs such as decisions. Cooper (2008) claimed that the "Stage-Gate" can accommodate open innovation processes in overlapping stages. Design activities may begin before the end of idea generation, and products testing may begin while they are not fully engineered. Some stages might be omitted and the process might move backward, and loops are inevitable.



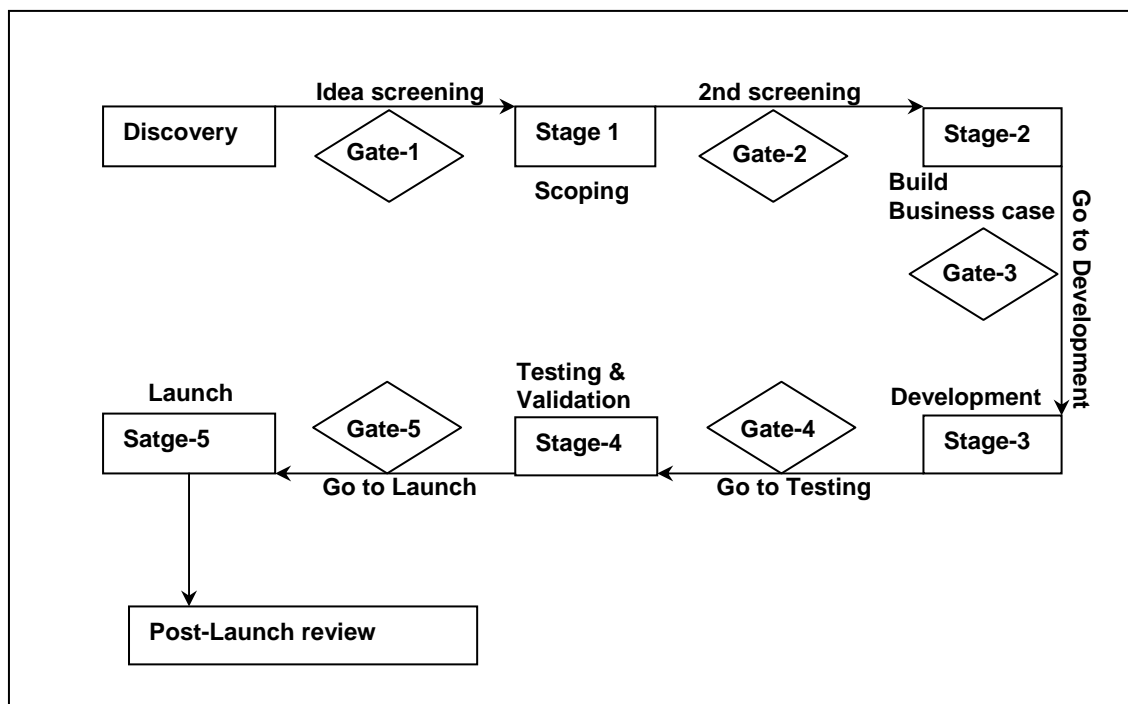


Figure 3.2: Cooper's Stage-Gate model for NPD process, (Cooper, 2001)

An alternative model for R&D implementation is "Development Funnel", see Figure 3.3 (Goffin and Pfeiffer, 1999; Hauser et al., 2006). Goffin and Mitchell (2005) highlighted that this model is not new because Majaro (1988) and Wheelwright and Clark (1992) have previously used it. Herzberg (2006) interpreted this model as a mixture of Cooper's "Stage-Gate" and the concept that ideas become more concrete over time. It therefore introduces different management dimensions. The number of ideas or concepts is large at the beginning and decreases towards the end when the more concrete ideas are left (Hauser, 2006).

The width of the funnel represents the strategic vision of the firm. Ideas are reviewed in the first stage and the most promising ideas proceed to product definition and development. After detailed reviews the perceived best products are tested and evaluated in order to enter the stage of product launch. Herzberg (2006) suggested that the model shows similarities to Cooper's "Stage-Gate" although Goffin and Mitchell (2005) argue that strategy development is a parallel activity to the process of idea generation. A difference, however, is that

the funnel model allows failures to proceed to development stage knowing that for one successful project there are many failures (Hauser, 2006).

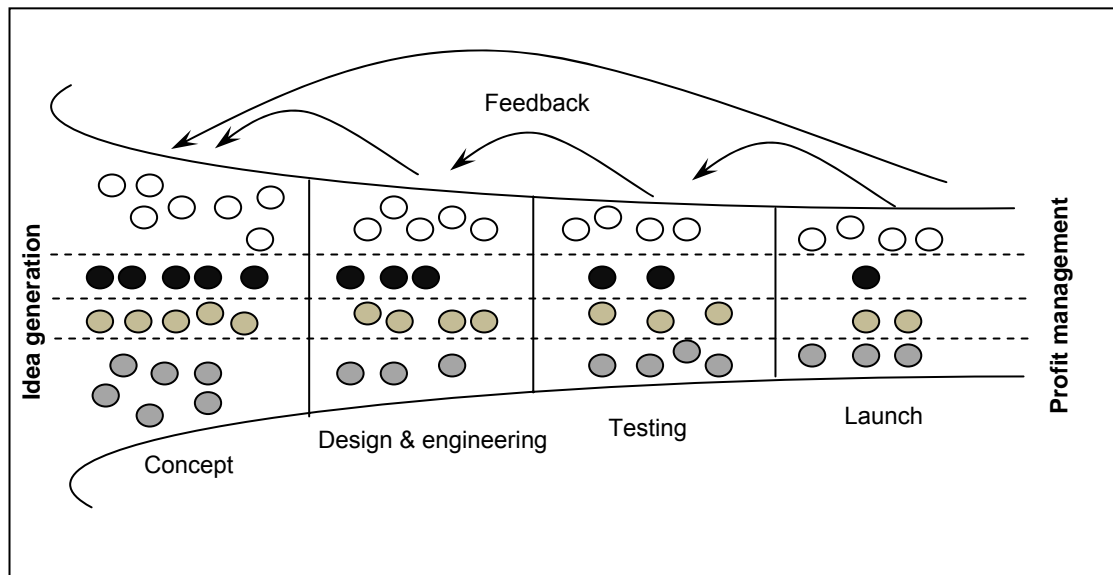


Figure 3.3: The development funnel model for R&D and innovation projects, (Hauser et al., 2006).

Goffin and Mitchell (2005) used the “Development Funnel” model and added two elements; innovation strategy, and people and organisation. Innovation strategy links the projects portfolio to a firm's strategy, and the people and organisation dimension is added because management of people is important for implementation. These two elements are not part of the process, rather the process is a multi-dimensional and metaphorical “Pentathlon” rather than “Marathon”. Although these two elements are contextual to the innovation process, the process itself is still linear.

Linear models are criticised as they do not provide an explanation for the development of the majority of breakthrough innovations (Leifer et al., 2000; McDermott and O'Connor, 2002). In radical innovations, projects require a longer time for implementation. They face a risk of changes in management members. Priorities may change with new management members and this adds another level of uncertainty to the process. Further, harsh reviews and controls may hinder potential success of radical NPD (Sethi and Iqbal, 2008). The

models also fail to consider behavioural influences, external environmental changes (Olin and Wickenberg, 2001; Bonner et al., 2002) and political issues.

### 3.5.2 Non-linear approaches

One of the non-linear models is the spiral model (Boehm, 1988; Hauser et al., 2006). The model represents a risk-driven process in which stages (spirals) are concurrent rather than sequential (Figure 3.4). It begins with objectives and alternative methods of implementation. The constraints and risks of each alternative define the implementation strategy which determines time and resources requirements. In comparison to linear models, activities in the spiral model are assessed in “successive passes”. Activities that pass an assessment proceed at greater speed and lower cost. Speed is the main focus of the spiral model with frequent functional feedbacks. In the spiral model the R&D process is repeated many times as the project “spirals” to completion (Hauser et al., 2006).

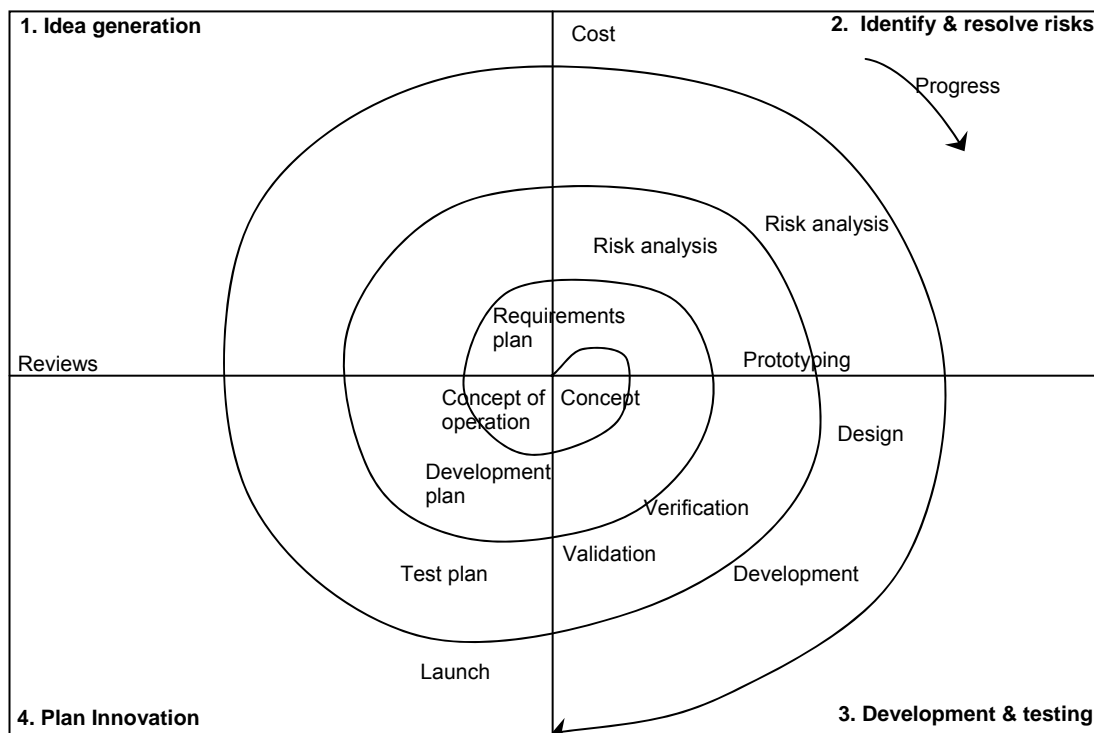


Figure 3.4: Spiral model for innovation management, Source Boehm (1988) with modification.

Another non-linear model is the “Chain-Linked”, see Figure 3.5, (Kline, 1990). Kline assumed that development activities contribute to innovation more than research. Research contributes to the implementation process rather than initiating it. The process starts with a new market opportunity and/or a new invention. Conceptual design leads to detail design, production, marketing and distribution. Feedback loops link different stages of the process and research intervenes whenever a problem rises during implementation.

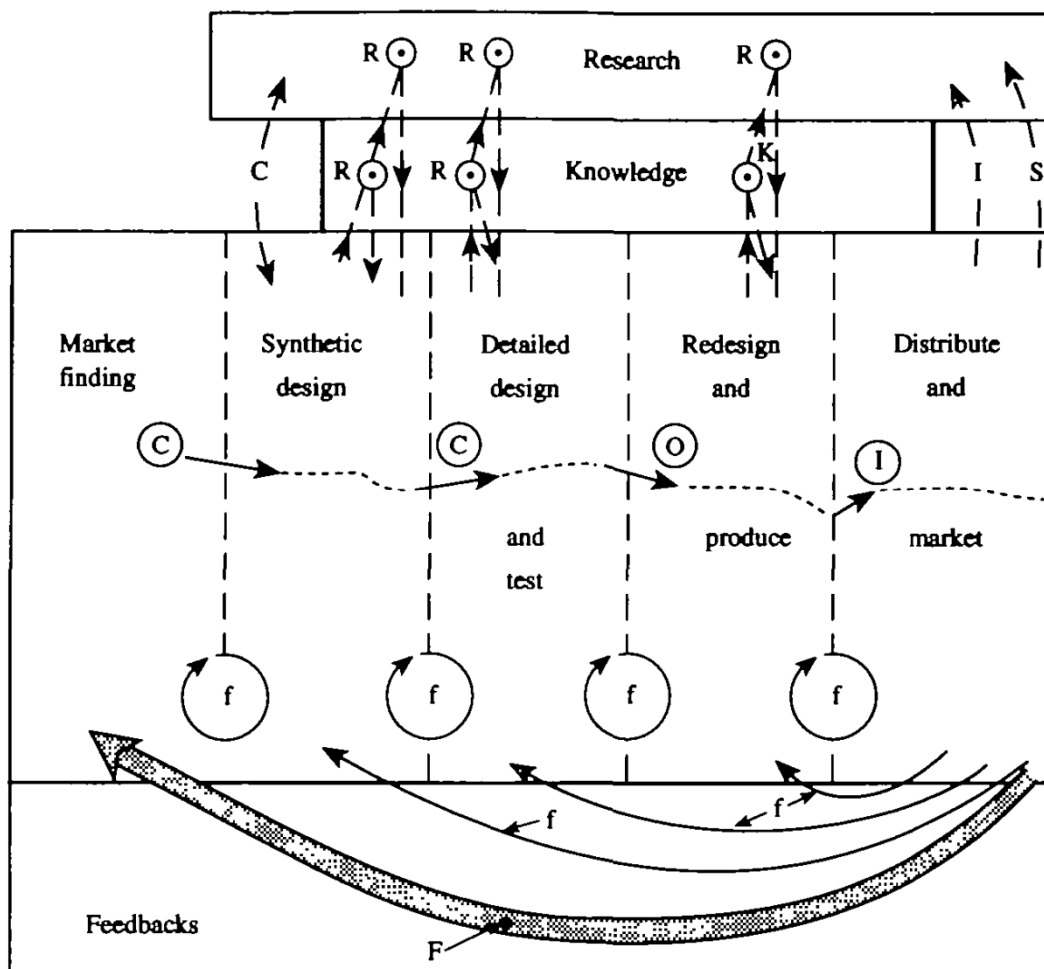


Figure 3.5: The chain-linked model of innovation. Link I supplies instruments from manufacturing sector to scientific research. Link S supports fundamental research in industry. Link C is a two-way flow of ideas between scientific research and synthetic design. Links K and R link knowledge and research utilized in innovations. (Kline, 1990).

Hauser et al. (2006) and Cooper (2008) argued that the non-linear models are not substantially different from the overlapping stages in Cooper's "Stage-Gate". In the latter, events could start before the end of the previous stage. MacCormack (2001) argued that prototyping stages are not part of the design but representations only. The bulk of the design work is carried out after prototyping is completed, in a similar approach to that of the linear models. Although, feedback frequency is more in the non-linear models these fail to consider the influences of irrational<sup>6</sup> human behaviour such as faith, sentiment, will, mind-set and intuition (Guo, 2009). In organisations, staff with common feelings, attitudes and values form informal organisation or interest groups besides the formal one (Pindur et al., 1995). This group structure may influence R&D implementation processes (see Section 3.6.3).

It could be seen that factors influencing R&D performance, Table 3.1, are related to the processes of implementation. Authors emphasised not only the effect of identifying the right R&D projects but also implementing them correctly. However, despite the formal process of selection and monitoring, research suggested that only a few R&D projects had been successfully transferred or implemented into products and services (Griffin and Page, 1996). Often management found itself dealing with a significant gap between approved R&D objectives and implemented ones. One needs to understand the process of implementation in general terms and the literature of strategy implementation is reviewed to develop a broader understanding of how implementation processes work in general. A general understanding of the implementation approaches could bring R&D processes out of existing "Corner View" and highlight potential answers to the shortcomings of R&D implementation models.

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<sup>6</sup> Many people see irrational behaviour as oppose to rational, conscious and tuition behaviours. In this paper, it refers to unpredictable behaviours in a formal organization setting (Gue, 2009).

### **3.6 APPROACHES TO IMPLEMENTATION STRATEGIES**

The literature on implementation is inconclusive and fragmented because it spans multiple disciplines (Dufour and Steane, 2006). It has evolved into three different sets. The first assumes implementation as an automatic process once the right strategic programmes are formulated. The second assumes implementation as a process not less complex than strategy formulation. The third set attempts to understand how implementation processes work in general (Brynard, 2005). Hence, there are diverse perspectives in defining the concept of strategy implementation. With the focus on the processes involved, it can be seen as resource allocation, communication, execution, and enactment of R&D strategic plans and objectives (Nobel, 1999).

Four implementation approaches have been identified; Classical, Contingency, Behavioural and Political (Dufour and Steane, 2007). These approaches are overlapping and could be used in several combinations to explain why problems exist in implementation processes. Combinations of perspectives during strategy development carry over to implementation processes (Bowman and Kakabadse, 1997) and could cause overlaps in implementation approaches.

#### **3.6.1 The classical approach**

Classical approach goes back to the classical management school. This school utilises scientific ways to improve productivity and make organizations more effective and efficient (Pindur et al., 1995). Classical approach assumes organisations are “well-insulated” entities where partisan, emotions and political reactions do not exist. Organisations are predictable environments and success is achieved by planned actions (Pettigrew, 1982; Mintzberg, 1984; Dufour and Steane, 2007). Implementation is controlled from one centre of authority and takes place through directives from leadership (Nonaka, 1994; Dufour and Steane, 2007; Mohammed and Richardson, 2007). The main focus here is to arrive at efficiency through four perspectives:

*Rational planning perspective* assumes that rationally planned actions and proper methods deliver successful implementation. Success or failure of implementation is assessed against the stated plans.

*Decision making perspective* focuses on the success factors of implementation throughout the decision making process. It imports good reason into a top-down implementation process. Good reasons improve the efficiency and effectiveness of decision making (Dufour and Steane, 2007).

*Rational tools perspective* assumes that relevant techniques, technologies and tools increase planning comprehensiveness, reduce incrementalism and lead to successful implementation (Dufour and Steane, 2007).

*Ideal condition of implementation perspective* presumes that implementation succeeds in perfect organisational conditions. Leaders rectify implementation processes with the use of the other three perspectives. They eliminate difficulties and ensure adequate time, sufficient resources, team motivation, proper communication and senior management support (Dufour and Steane, 2007).

Authors criticise the classical approach because it assumes implementation as a technical, non-behavioural and/or non-political activity. It believes that rational leaders' directives can lead to success (Dufour and Steane, 2006). It assumes organisation as a closed mechanical system and does not consider the influences of external environments. It analyses implementation process with rationality in terms of what should be done. A range of external as well as some internal factors involved in implementation may not be rational (Dufour and Steane, 2006). Workers are not necessarily economic individuals whose motivation is all about money (Pindur et al., 1995). The ideal condition perspective views organization as a stable environment and implementation of new programmes would destabilize it (Clarke, 2001).

Moreover, the classic approach is an orthodox view which values the traditional and hierarchical functional roles (Clegg and Hardy, 1996). It emphasises

improvement of plans with the use of feedback mechanisms (Dufour and Steane, 2007). The feedback system is, itself, linear which does not reflect the reality of the complex situations of organisations. Stacy (1995) argued that organizations are nonlinear network systems and that feedback systems are also dynamic and nonlinear network systems. In simple terms, the actions of one person lead to reaction by another which becomes an action that leads to a second reaction, probably by a third person, and so on. The result is a network of nonlinear feedback systems.

### 3.6.2 The contingency approach

Contingency approach goes back to the contingency theory of the modern school of management. Contingency theory is a problem-solving approach which takes into account all major factors in a situation before making a decision (Pindur et al., 1995). It assumes organizations are in agreement with their internal and external environments. Like the classical approach, contingency approach views the implementation process as a series of technical and administrative activities (Dufour and Steane, 2007). Unlike the classical approach the contingency approach includes exchange relationships between organisation and the technical and technological environment surrounding it (Pettigrew 1987 and 1990; Caldwell, 2005; Dufour and Steane, 2006 and 2007). Leaders have to choose between various structures and processes to achieve the best fit with both environments, and design a top-down implementation process accordingly. The approach extends the classical approach and encompasses two perspectives:

*Contingency perspective* views implementation as technical, contextual and technological processes. Decisions are made rationally to fit strategy content to contextual factors. *Fit perspective* places technical and administrative processes in line with intended programme and contextual factors (Dufour and Steane, 2007).



The contingency approach has been criticized, for example, Bumes (2004) found difficulty in identifying critical contingency variables. Contingency perspective assumes a rational consciousness in the decision-making process (Dufour and Steane, 2006). In this it follows the classical approach and assumes ideal conditions for implementation but in best fit perspective. In addition it neglects behavioural and political issues in the implementation process.

### **3.6.3 The behavioural approach**

Behavioural approach goes back to the school of behavioural management. This school focuses on human psychology, motivation and leadership (Pindur et al., 1995). Behavioural approach deals with human actions and traces them back to their motives (Mohammed and Richardson, 2007). It incorporates individual sources of hindrances in implementation in addition to organizational ones. More emphasis is given to individual motivation, commitment and interpersonal cooperation in the implementation processes (Nonaka, 1994). It assumes that organisations comprise many interest groups (formal and informal). This assumption considers irrational, creative, and intuitive influences. Relationships between managers, supervisors, subordinates and peers affect the process of implementation (Pindur et al., 1995). The approach encompasses three perspectives (Dufour and Steane, 2007):

*Diffusion perspective* assumes initiatives from individual staff members are more achievable than those arising from external sources. The way the programme is communicated can, in addition to influential leadership, lead to successful implementation. The leaders' role is limited to setting the way forward for the implementation team and providing direction. The team with a shared vision and values would facilitate implementation themselves. Failures occur as a result of lack of consensus and commitment among implementation teams.

*Corporate culture* perspective assumes organizational culture (shared beliefs, norms and assumptions) as a source of either support or resistance to implementation. Implementations require rethinking the processes of organizational culture because these could become “invisible barriers” to the implementation process later on.

*Organisational change and development perspective* considers individual attitudes, interpersonal relations and organisational climate (Dufour and Steane, 2007). The assumption is that failures result from negative attitudes and/or interpersonal relations among implementers, or from lack of a proper organisational climate.

The behavioural approach is criticised for its focus on internal organizational culture and programme content. It neglects the broader contextual explanation of implementation processes (Dufour and Steane, 2006) and treats implementation as a sequential process with historical and direct contextual influences. It distances itself from the immediate but indirect context (Pettigrew, 1987). The re-shape of organizational culture to facilitate implementation of change is easier to say than to do. Another limitation is the difficulty in the prediction of complex human behaviour (Pindur et al., 1995). It also avoids the problem of power and conflict of interests in implementations (Mohammed and Richardson, 2007).

### **3.6.4 The political approach**

The political approach focuses on the impact of power and political behaviour on implementation processes (Dufour and Steane, 2006). It investigates various sources of power such as technical skills and knowledge and other forms of control over allocation of resources (Kakabadse et al., 2004). Contradicting ideas of what is right and wrong could establish a threat of what is known as “misunderstandings” (Kakabadse, 1987). When this occurs, an individual or group rejects or responds with inappropriate behaviour to the action of the other. This situation becomes

*“a negative interaction which usually leads to non-productive consequences. It is the political animal who recognises that people/groups are different and acts accordingly”.* (Kakabadse, 1987, p 35).

The political approach acknowledges the existence of contestation, conflicting interests and bargaining in organisations as endemic rather than exceptional (Senge, 1990; Knights and Murray, 1994; Wenger, 1998; Caldwell, 2005; Dufour and Steane, 2007). It encompasses three perspectives to overcome them:

*Bureaucratic process perspective* deals with staff maturity and its effects on implementations (Caldwell, 2005; Dufour and Steane, 2007). It helps understand the sources of power among those who have the interest and skills to control resources. The emphasis is on enabling programmes emerge upward and to encourage managers to make decisions that fit the long-term interests of the organisation. It uses transitive and/or generative modes of decision making. The transitive mode is open dialogue strategy between top and lower management, while the generative one limits top management interaction to selection and approval of proposals (Bowman and Kakabadse, 1997).

*Bargaining and negotiation perspective* assumes that the outcome of certain implementation is a reflection of interest of certain groups. It is important to survey internal and external interests in any implementation and adopt a bargaining strategy to influence other groups.

*Symbolic implementation perspective* believes that power can be used to produce preferred outcomes. It adapts instrumentalism and symbolism theories to accomplish longer term objectives (Dufour and Steane, 2007). Instrumentalism overcomes the assumption made by Clegg and Hardy (1996) that a successful implementation does not mean success in the longer-term. Symbolism uses political language and symbols in implementations to support it and also to reduce the opposition around it. The rationale of symbolism is that power is a predicting factor in the process of resource allocations. The use of symbols and political language helps identify powerful groups. The clearer the

picture of the powerful groups the more efficient the bargaining approach (Dufour and Steane, 2007).

The political approach is criticised for its focus on power and the influence of interests and may underestimate the influence of rational and collaborative processes (Dufour and Steane, 2007). The approach is cynical in nature, overstates the influence of conflict and underestimates the potential for the effectiveness of collaboration. It also lacks prediction of problems and does not suggest improvements to the process of implementation (Mohammed and Richardson, 2007).

### **3.7 CONCEPTUAL FRAMEWORK**

The literature on R&D in the context of Oman and its neighbourhood is very limited. The only study that was found is Jawad (1995). It covered ITA acquisition projects. Because of this the literature on R&D that is published in the west was used. Despite the differences of academic culture and market scale, there are some similarities between the two contexts. Highly qualified personnel are involved in both settings. Such qualification is expected to influence their intellectual skills and R&D capability in similar ways. This is further supported by the fact that faculties at SQU are multi-cultural. Further, the nature of R&D is not obviously different in Oman from that in the west. Nevertheless, the differences between the two contexts may introduce some new success measures and factors.

Studies of success of R&D conclude lack of one universal model, rather the impact of implementation is context based (Balachandra and Friar, 1997). In an academic context, Pilbeam (2002) explored implementation factors in publicly funded research in agriculture. Although the study was in the background of the transition in Higher Education systems success definition was not emphasised. The study was limited to agricultural research where end-users are relatively easier to determine. The present study includes all fields in a university context. Disciplines exist alongside each other in the same academic environment and compete against each other for the same resources.

Models of R&D projects view implementation processes from the points of view of classical and contingency approaches. They account for technical, technological and administrative factors in R&D implementation but underestimate the influence of behavioural and political factors such as power and conflict. Gates' criteria in the "Stage-Gate", for example, emphasise three issues; first good execution of the project (on-time, to-budget, reliable data, etc.). Second, is the strategic focus (strategic fitness, competitive advantage, leverage to capabilities, etc) and the third is the way forward (plans, resources, etc.) (Cooper, 2001). They assume that R&D organisations are "well-insulated" from partisan emotions, political reactions and contextual factors, and that decision makers are rational and decisions are taken to best fit the content of the R&D programme. However, they ignore the irrational, creative and intuitive influences of the human side (behavioural approach). They also ignore the potential threat of misunderstandings and conflict (political approach).

The present study explores the effects of rational and irrational behaviour in implementation processes, on the performance of research projects. The findings of Pilbeam (2002), Goffin and Mitchell, (2005) and Ottenbacher et al. (2006) may support the belief that beside the effects of rational behaviour there are the effects of irrational behaviour. Pilbeam (2002) found some factors such as "Degree of interestingness" and "Degree of fun the team find in the project". These may suggest behavioural influences on the performance of a research project. He also found the "Imposed idea" of influence which may suggest political influence on R&D implementation. Ottenbacher et al., (2006) found that the "Involvement of employee" significantly influences the degree of success of NSD. This may be interlinked with the ownership feeling of the staff members towards the new service. Goffin and Mitchell (2005) enhanced these believes by adding the element of **"People and Organisation"** to the "Development Funnel" model.

The objective of this study is to explore technical, administrative, behavioural and political influences on university research. A framework of four implementation approaches has been developed, see Figure 3.6. Rational

behaviour in the processes of R&D implementation is considered and dealt with by the classical and contingency approaches. The behavioural and political approaches consider and deal with irrational behaviour in R&D implementation processes.

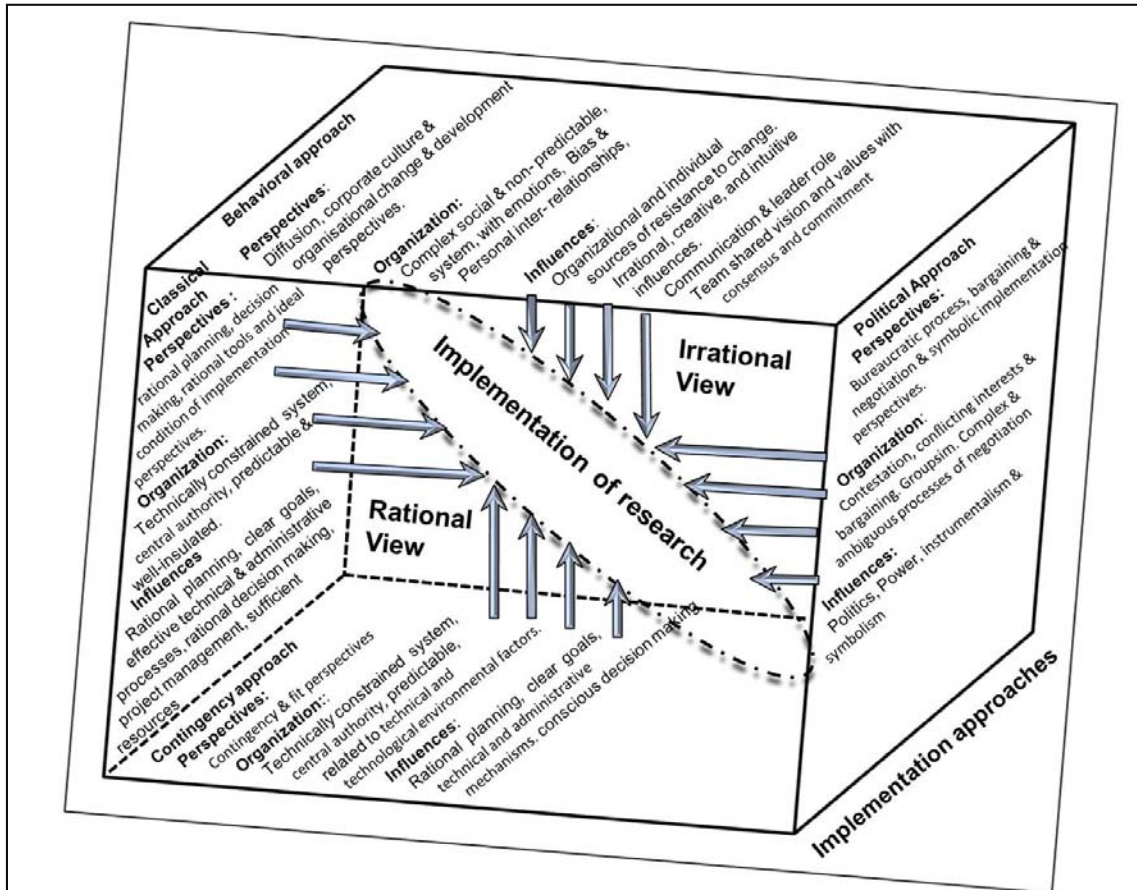


Figure 3.6: Implementation of university research viewed as a 3 dimensional visualisation of the strategy implementation literature, by the author.

At the start of the study, the objective was to explore how performance of research in SQU could be improved. After the literature review the main research question has become:

***How does R&D implementation influence the performance of publicly funded research in SQU?***

The following sub-questions could be of help to answer the main one:

- What constitutes success for publicly funded academic research?

- What components of R&D implementation influence the performance of research in SQU?
- How do these components integrate (or not) to influence the performance of research in SQU?

### **3.8 SUMMARY**

This chapter has reviewed the literature concerning success measures and factors in the fields of R&D and innovation projects. HERG's payback model was found a good place to start this study. It is used to measure the impact of publicly funded NHS research projects. The review identified 221 effects which were grouped into four logical categories. R&D models were also reviewed. Some of these models are linear while others are non-linear.

To understand implementation in general, some works on strategy implementation were reviewed. These showed that R&D models addressed implementation from technical and administrative perspectives only and overlooked the behavioural and political influences. Research opportunity was identified and the way forward was presented. Finally the implications of this review on the research question were highlighted. Next chapter discusses the design of the research method and related issues.

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## 4 METHODOLOGY

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### 4.1 INTRODUCTION

It was part of the condition of the support given to the researcher by his employer that the findings should be particularly applicable to the needs of the sponsoring organisation. Easterby-Smith et al., (1991) endorsed that when working directly for clients or patrons it is very important to tie the research very closely to the questions that the sponsors want answered. Furthermore, one of the five features considered to characterise the antecedents of successful research is real world value i.e. a problem arising from the field and leading to tangible and useful ideas (Robson, 1993).

The changing mode of operation in the higher education sector and the consequent demands for effective management of research projects in universities were the main drivers behind this study. The ultimate aim is, therefore, to provide guidelines to enhance the quality of the management of research at individual project level in universities. This exploratory study attempts to gain a deeper understanding of implementation effects on the performance of academic research. The development of ideas and constructs flows from the research data as opposed to data being used to support any prior theoretical models and hypotheses. Therefore this research takes an inductive/retroductive qualitative grounded approach.

This chapter is split into three main sections: Firstly a discussion of the research philosophy, the ontological and epistemological assumptions of this research, making the case for qualitative, interpretive research. The second section considers the research methodology and how the research strategy fits with the philosophical assumptions. The third section considers the data collection methods and analysis tools used. Before that, however, readers are reminded of the research question.

#### 4.1.1 Research question

The main research question of this study is

***How does R&D implementation influence the performance of publicly funded research in SQU?***

The following sub-questions could be of help to answer the main one:

- What constitutes success for publicly funded academic research?
- What components of R&D implementation influence the performance of research in SQU?
- How do these components integrate (or not) to influence the performance of research in SQU?

#### 4.1.2 Purpose of the research

Five purposes for research are highlighted in the literature of research management (Kervin, 1992). The first is exploration where the study seeks to identify important dimensions of the problem and generates possible explanations. Second is a description where the researcher intends to obtain information about the characteristics of a current situation. Third is to predict what the situation will be like in the future. Fourth is evaluation research which assesses the effect of a certain action, programme or policy. The final and ultimate purpose of any study is explanation which intends to determine the causes of any problem.

Because of the nature of the research question in this study (How question), exploration purposes are assumed. Exploratory studies are conducted into situations where very few or no earlier studies have been conducted (Hussey and Hussey, 1997). The very purpose of an exploratory study is to seek out new insights, ask questions and assess phenomena (Adams, 1985) to clarify the nature of problem. As indicated in chapter three, studies of success of R&D showed there was no one universal model, rather the impact of implementation

is context based (Balachandra and Friar, 1997). In an academic context, the transition in Higher Education systems poses a degree of vagueness on the definition of R&D success. This ambiguity is also reflected in the attributes to research successful performance. The aim of this study is, therefore, to identify performance measures and implementation effects on performance of academic research. In conclusion, the nature of exploratory research suits the objective of this study.

Exploratory research is much less structured than other research (Adams, 1985). It relies on empirical methods such as interviews and case studies. Exploratory research generates ideas for future research rather than testing or confirming a hypothesis (Hussey and Hussey, 1997; Robson 2002). To this end, the aim of this study is to create a base on which future research can build. For example, a correlation of implementation effects and measures to develop a framework for success prediction is one of the possibilities.

## **4.2 RESEARCH PARADIGMS**

A research paradigm is the basic set of beliefs that guide human research actions (Easterby-Smith et al., 2002). It deals with four research concepts; axiology (the role of values in inquiry), ontology (the nature of reality), epistemology (the relationship of the knower to the known) and methodology (the best means to arrive at knowledge about the world). These concepts are summarised in Table 4.1.

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<b>Concept</b>	<b>Description</b>
Axiology	The role of values in inquiry (biased vs. unbiased)
Epistemology	The relationship of the knower to the known
Ontology	The nature of reality
Methodology	The best means to arrive at knowledge about the world
Method	Individual techniques for data collection and analysis

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Table 4.1: Definition of research concepts, adapted from Easterby-Smith, et al. (2002)

Ontology concerns the nature of existence. A researchers' ontological assumptions affect his/her views of the world and what they conceive "real" (Blaikie, 1993). Epistemology concerns the nature of knowledge and how to come to know the "real" (Blaikie, 1993 and 2000; Healy and Perry, 2000). Ontological perspectives shape the epistemological beliefs in terms of how knowledge of reality develops (Blaikie, 1993). Both ontology and epistemology are influenced by axiological and methodological assumptions (Johnson and Duberley, 2000). Axiological assumptions answer the question of whether research is value-free or value-laden. These are assumptions regarding the role of values in inquiry; in other words can values be suspended in order to gain knowledge, or do values mediate and shape what is known. In the former position the researchers are detached whereas in the second they are part of what they study (Hussey and Hussey, 1997). Methodological assumptions consider the overall research process.

There is no solid enough foundation from which considerations of human knowledge of knowledge may begin (Johnson and Duberley, 2000). This is, caused by the lack of neutral platform to evaluate the different perspectives of research paradigms (Blaikie, 1993). Therefore it is the responsibility of the researcher to clarify his/her own philosophical research paradigm in order to ensure the quality of his/her research. The following sub-sections provide an overview of research paradigms. Different ontological and epistemological assumptions are highlighted. The selected research paradigm "Realism" for this study is discussed and a description of its ontology and epistemology is provided.

### **4.2.1 Overview of research paradigms**

Philosophers and methodologists have been engaged in a long standing debate about how to best conduct research (Patton, 1990). The essential debate is between the positivism and the constructivism paradigms. Positivism was, for centuries, the dominant perspective for knowledge enquiry. Its ontological assumption is that reality is "out there", it is single and objective (Easterby-

Smith et al., 2002). Its epistemological perspective, therefore, dictates that reality can be assessed by the researcher who can remain independent and neutral all the time (i.e. value-free axiology). Because of these ontological and epistemological assumptions, positivist research follows a deductive approach (Easterby-Smith et al., 2002). It uses quantitative data to testify or falsify pre-formulated hypotheses. Consequently, such a strategy is more likely to test theories than to build them. In organisation and management enquiries, the objective of positivism paradigm is to discover the fundamental laws that govern organisational process and operation (Johnson and Duberley, 2000).

The constructivism or interpretivism paradigm, however, exists at the other end of the continuum from positivism. It conceives the world as a social construct by means of people's meanings and interpretations and their motives and intentions that direct their behaviour in their everyday lives (Blaikie, 1993; Easterby-Smith et al., 2002). Because of this social construct of the world, reality is a product of social interactions that do not produce single realities but multiple ones constructed in multiple contexts (relativist ontology). Consequently this could mean that there is no objective reality that can be discovered; in this it contradicts the detached positivist perspective. Constructivism implies subjectivity in which the main concern is how social objects are made meaningful by actors in the "life world" (Easterby-Smith et al., 2002). This means that social constructivists are part of what is being studied (value-laden) and observations are interpreted consciously (Easterby-Smith et al., 2002). Social constructivists use an inductive approach in qualitative inquiry to understand actors' thinking and feelings in order to explain their actions.

Between the poles of positivism and constructivism, perspectives that do not wholly reject all tenets of either can be identified. These perspectives attack positivism's adherence to the view that reality is objective and external arguing, instead, that reality is socially constructed and given meaning by people (Bhaskar, 1978; Denzin and Lincoln, 1994; Easterby-Smith et al., 1994; Guba and Lincoln, 1994; Healy and Perry, 2000). Concurrently, they challenge the

constructivism to the view that there is only a socially-constructed reality (Johnson and Duberley, 2000).

Having bounded the philosophical field, delimited by positivism and social constructivism, it is necessary to outline the philosophical location of the current research. The following sub-sections draw conclusions for the selected philosophical approach.

### **4.2.2 Selection of research paradigm for this study**

Blaikie (1993) proposed that the choice of research perspective can be legitimised in several ways; matching perspective to research project in a pragmatic fashion or driven by a particular worldview. For example, a relativist approach introduces personality factors that determine preference for the status of the researcher (insider or outsider) or the social context of the researcher and the researched topic. The ontological assumptions (nature of reality) and the nature of the phenomenon under investigation affect the epistemological perspective of this study (how to gain knowledge of the reality of the studied phenomenon). Research ontological and epistemological assumptions explain the choice of the philosophical position of this research.

#### **4.2.2.1 Inappropriateness of positivism for this study**

Some problems were encountered the use of positivism in this study. First, positivism states that direct experience, accumulated in the form of data through the observer's senses, is the only reliable and legitimate basis for knowledge (epistemology). However, social research frequently encounters phenomena that are not easily observed, and are consequently discounted from the positivist epistemology (Johnson and Duberley, 2000), for example "values" or "culture". Perceptions of academic researchers about what R&D success and failure mean and what causes them is dependent on the human behaviour and "values" and "culture" within which they are embedded. Positivism does not suit this research because it suggests a single, uniform and concrete reality. It

denies the social realities of success and failure, and their attributions as perceived by the academics' meanings and interpretations, and their motives and intentions (not totally objective).

Second, because of its rejection of the human "values" and "culture", positivism resists the establishment of empirical truth. It treats respondents as independent "objects" who do not reflect their meanings, interpretations and intentions on the topic of study. It, therefore, lacks explanation of social behaviour. Third, the study of social phenomenon also means that it is impossible to be detached from the phenomenon. The researcher needs to be (value-laden) part of what he studies to interpret, consciously, the observations he makes (Easterby-Smith et al., 2002). This contrasts with positivism, where researchers separate themselves from the world they study in order to stay neutral (Blaikie, 2000). Positivism has been found inappropriate to study phenomenon that involves human real-life experiences (Robson, 1993).

After the consideration of these problems, the positivism stance was overruled as an option for this study.

#### **4.2.2.2 Inappropriateness of constructivism for this study**

The use of constructivism in this study was also found problematic. Constructivism isolates human actions from the economic and technological dimensions (Hunt, 1991). It views perception of respondents by itself as reality. In this study, however, academics' perception, of their R&D performance and attributions to it, is not seen as reality in itself. Their perception is only one of the many views about reality. The existence of an independent single reality is not necessarily inconsistent with the notion of individual's perception of this reality (Bhaskar, 1978; Blaikie, 1993 and 2000). The world exists without any human awareness of this existence being necessary (Connelly, 2000) and some real phenomena may exist that cannot be measured by our senses, such as "values". Bhaskar (1978) called those phenomena which are independent of identification by human enquiry "intransitive objects". Conversely, "transitive

objects” are those that are socially constructed and allow us to make sense of the social world.

The social reality as seen by the researcher and the nature of the phenomenon being studied require a research philosophy that is conscious of the values of human systems and recognises differences between reality and people’s perceptions of reality. These conditions could be found in “Realism” (Bhaskar, 1978; Healy and Perry, 2000). It is discussed in the next sub-section.

### **4.2.2.3 Realism as an appropriate paradigm for this study**

Realism paradigm exists between the philosophical extremes of positivism and social constructivism. It shares the same primary ontology of positivism in that it accepts the notion of reality existing independently of the observer, yet it disagrees that positivistic methods are the only legitimate ways of coming to know that reality or part of it. Positivism’s methods are not rejected, in contrast to the absolutism that comes with it (Johnson and Duberley, 2000). The aim of the realist approach is to “dig deeper” to improve the understanding of the mechanisms that underlie the studied phenomena through critical exploration. In this it goes beyond the positivism’s thesis.

#### **4.2.2.3.1 Realist ontology**

Realism rejects subjectivist ontology of the constructivism by asserting the existence of a single concrete reality (Blaikie, 2000). This poses the importance of understanding the general patterns of certain behaviour by groups of people. Concurrently realism rejects positivism by viewing reality as a social construction. By this, it assumes the usefulness and validity of understanding individual behaviour and perception to arrive at reality. This inconsistent ontological of partial support and rejection of the two paradigms was resolved by Bhaskar (1978).

In the realist perspective, reality is held by generative mechanisms (the real), which produce events (the actual) which may, or may not, be experienced (the



empirical). While positivism searches for empirical regularities and direct cause and effect paths, realism looks for underlying generative mechanisms, structures or causal powers (real). This real appears under specific conditions in concrete events (actual) which can be experienced in the empirical domain.

Causal impacts in realism are not fixed but contingent upon their context. The real does not necessarily follow the pattern of the actual, nor does it necessarily follow the experienced empirical (Blaikie, 1993). These levels of ontology differ from that of positivism where the three are bundled into one level (Petrovic, 2006). Consequently in realism, empirical regularities are not sufficient nor are they necessary for establishing a causal law (Smith, 1998). The researcher, therefore, does not gather facts or counts how often certain patterns occur as is the case with positivism. The researcher covers several contingent contexts and different reflective participants to develop a group of answers. These answers reveal the generative mechanisms that operate in the world (Healy and Perry, 2000).

#### **4.2.2.3.2 Interpretive epistemology**

Realism accounts for different meanings that people place upon their experiences (Johnson and Duberley, 2000). In this, realism shares the constructivism view. The human systems (of the respondents and the researchers) reflect an individual's experiences and make these experiences different. Therefore realism understands those respondents' perceptions influenced by their values and beliefs which make them limited. Truth is hard to pinpoint and reality can only be approximated. That is to say, generalisations derived from realist research hold probabilistic truth not absolute truth (Easterby-Smith et al., 2002). Realism is "value aware" which is different from positivism objective "value free" and constructivism very subjective "value laden" approach (Perry et al., 1998).

The first stage in the process of realist sciences is to explore the unknown, then to check the authenticity of what is thought to be known (Blaikie, 1993). In explorative inquiries, the researcher may have an idea about the direction in

which to go but seldom a clear idea of what results to expect. Realist explorative research studies events and phenomena in the empirical domain. It uses the recollections of those who have experience of these events and phenomena. This approach is thought to be consistent with the objectives of this research. Ultimately, realism aims to explain and predict, however this research holds back from these objectives and is restricted to exploration with a view to informing future explanatory studies. Table 4.2 illustrates the extremes of philosophical continuum and suggests realism for this research.

### **4.2.3 Summary of the section**

In this section the extremes of the philosophical continuum (positivism and constructivism) were discussed. These extremes were found not suitable for this exploratory research which includes a “how” question. The nature of the phenomenon of this study does not wholly support any of these paradigms. The role of the investigator in such phenomena suggests the use of constructivism. However the constructivist approach assumes academics perceptions of success and failure and their attributes as “real” while they are assumed here as one of the many views about reality. A midway paradigm realism was suggested for this research. Its realist ontology and interpretivist epistemology indicate the appropriateness of this paradigm for this exploratory study.

	<b>Positivism</b>	<b>Realism</b>	<b>Constructivism</b>
<b>Ontology</b>	<p>Reality is: external and independent of the observer Objective and ordered Single Belief in laws, uniformity and generalisability of knowledge Reductionist and deterministic</p>	<p>Reality : exists independently of what anyone thinks, believes or knows about it and how people perceive of it Social structure is critical - all human agency (action) has meaning within the pre-existing social structures in which the actor exists</p>	<p>Reality is: socially constructed and apprehend-able in multiple forms Interpretive: socially and experientially based Changing realities A product of human minds and has no independent status of its own, reality is determined by meanings individuals give to experience</p>
<b>Epistemology</b>	<p>Value free acquisition of sense data accessible by the scientific process which is the only reliable foundation for knowledge Neutrality Dualism: researcher remains objective and exterior to the subject. Reduction of the natural world Homothetic (law giving) generalisations Direct experience Sense data Empirical verification</p>	<p>Need to explain causal relationships and understand how they came about Understanding general patterns of behaviour by groups of people (generalization) is important, but understanding individual behaviour and perception is a useful and valid part of research Science requires a “depth ontology” in which many kinds of evidence are valid - the directly observable rarely provides a full understanding or explanation of complex social phenomena</p>	<p>There is no neutral ground for knowledge since all observation is value laden Observer becomes part of what is observed Getting close to the subject Adopting a holistic view of social phenomena View social phenomena in their natural environments Idiographic (relating to individuals) generalisations</p>

	<b>Positivism</b>	<b>Realism</b>	<b>Constructivism</b>
<b>Objective</b>	Suited to the study of “It” beings to generate causal and fundamental laws of human behaviour Explanation, prediction, control	There are causal linkages or mechanisms that operate in all social phenomena, but cause and effect may not be direct	Suited to the study of human beings Those metaphysical things that positivism discounts or cannot access through empirical facts, such as values Understanding, exploration, emancipation
<b>Researcher</b>	Detached, independent, impartial	Researchers should strive for objectivity, but the researcher’s interpretation of what people say and do is valid as long as it is justified	Involved, interacts with the subject in order to gain understanding of the phenomenon
<b>Methods</b>	Natural sciences methods Measuring operationalised concepts Use of large samples Manipulation and control of isolated variables for the measurement of their relationships with others Uniformity and generalise-ability of knowledge	It is possible to separate structure and agency for research purposes but the two are equally valid and important aspects of social reality The choice of both research design and method is determined by the nature of the research question	Multiple methods to establish different views of the same phenomena Small samples investigated in depth over time Social constructions can be elicited and refined through interaction between the researcher and the respondent
<b>Context</b>	Not important: tends to discount contrary research findings as anomalous.	Important: searching for contextual reasons to provide a better understanding of actions and events that do not fit the theories applied.	Important

	<b>Positivism</b>	<b>Realism</b>	<b>Constructivism</b>
<b>Theory</b>	Theory testing; has a prior theoretical base	Theory building; has some prior theoretical base	Theory building; often not based on prior theory
<b>Strategy</b>	Deductive	Inductive/retroductive	Inductive
<b>Data</b>	Quantitative	Quantitative/Qualitative	Qualitative

Table 4.2: Philosophical perspectives of inquiry and implications for management research. Adapted from Blaikie (1993), Johnson and Duberley (2000) and Easterby-Smith et al. (2002).

### **4.3 RESEARCH STRATEGY AND RESEARCH METHODOLOGY**

The concepts of methodology and research method are commonly confused in the text books of management of research (Blaikie, 2000). While research method is the techniques and procedures used in data collection and analysis, methodology is the process of analysing, a critically, different research method. This section also discusses the logic of how newly justified knowledge is discovered. This section responds to the latter concept and starts with discussion about the different logic (strategies) of theory building.

#### **4.3.1 Research strategy**

Inductive approach derives its ontological assumptions from positivism (Blaikie, 2000). Social reality is single and objective. It can be known by human senses and by experimental or comparative studies. Inductive approach assumes that accumulative data introduces regularities or patterns. It generates models from common patterns and produces generalisations about these patterns. A limitation of this strategy is that concepts determine the type of data requirements.

Deductive strategies test generalisations or models in order to develop theories (Blaikie, 2000). It comes from a critical rationalist philosophical position. This position agrees with positivism in singularity of truth but disagrees on the epistemological approach to arrive at that truth. Observations as well as theoretical assumptions are “theory-leaden”. In deductive strategy, theoretical concepts are developed first. Data are then collected to reject or prove concepts. Proven concepts are not claimed true but provisionally accepted. Deductive strategy requires an inductive support to form a concept at first instant.

Retroductive strategy, like the deductive approach, starts with a conceptual development in an “empirical study” followed by explanation of regularities in a “theoretical study” (Blaikie, 2000). However, empirical study consists of

exploration and experimentation stages. The former extends what is known by common observations and develops a conceptual framework. The experimentation stage authenticates this framework. Theoretical study explains the regularities of empirical studies by uncovering generative mechanisms.

Abductive strategy comes from the constructivism paradigm. Its ontological assumption is that reality is multiple and contextual (Blaikie, 2000). It involves movement from description of social life to the actors' meaning behind it. It describes the meanings of activities and derives concepts and models to explain problems at hand.

Exploratory studies can be used as a basis for grounded theory development. Theory emerges through data collection and analysis (Easterby-Smith et al., 2002) although it is acknowledged, in the literature, that it is impossible to start "theory-free" in any study (Richards, 1993). Prior and emerging theories are often involved simultaneously therefore, no matter how inductive the approach, in theory building research prior theory (conclusions from the literature review) provides a focus to the data collection phase (Perry et al., 1998).

Realist inquirers first need to discover structures and potential mechanism which underlie the studied phenomenon (Blaikie, 2000). They then develop models as these structures are unavailable for observation in social sciences. Models are then tested empirically where successful tests conclude the existence of the hypothesised structure and mechanisms. Tests are repeated in order to explain these structure and mechanisms for ultimate theory building. Blaikie (2000) argued that "how" questions require a description of the desired state and detailed stages and procedures to achieve objectives. Blaikie, further, suggested for such complex situation, a combination of strategies might be the best option.

Following Blaikie's (2000) suggestions in the present study, an inductive literature review enabled the development of a theoretical framework to view the effects of R&D implementation approaches on its performance (Section 3.7). It assumed that there are some behavioural effects in the implementation of R&D.

Adapting a retroductive approach, data will be collected and analysed to explore R&D in university context. A model will then be developed. Finally recommendation for further validations, tests and modifications will be made.

### 4.3.2 Research methodology

As indicated earlier, research methodology deals with critical assessment of research processes to select the best one to answer the research question (Blaikie, 2000). Research design on the other hand, deals with steps used to answer the research question including methods for data collection and analysis.

The cross-functional nature of R&D involves a variety of disciplines like economics, marketing research, sociology and psychology, organisation research, technical disciplines and strategic management in its analysis (Herzberg, 2006). As a result different methodological approaches were used which caused several methodological shortcomings. Ernst (2002), for example, reviewed empirical NPD research over the last decades. He found that the very influential research works of Cooper (e.g. 1984 and 1990) and Cooper and Kleinschmidt (e.g. 1993 and 1995) remained unchanged, neither has developed their methodology for the last thirty years. Yet R&D organisations and research methods have changed very much (Herzberg, 2006). Other works of R&D follow the methodological approach used by Cooper and Kleinschmidt.

The choice of methodology for this research has been guided by several factors; researcher's philosophical assumptions, the nature of the research phenomenon, the research question and objective, environment/context, role of theory, the underlying theoretical framework, and the supporting literature in the field (Blaikie, 1993; Easterby-Smith et al., 2002).

As discussed above, the realism paradigm fits the researcher's view of social reality. Methodology selection, however, is not straightforward. Realism is open to both qualitative and quantitative methodologies (Hussey and Hussey, 1997; Easterby-Smith et al., 2002). Other influences, therefore, guide the selection of



methodology. The first influence is the nature of the study context. The second is the research phenomenon and the consequent research question. The third influence is imposed by the role of theory development. These influences are discussed below in detail.

#### **4.3.2.1 Influences of context**

In management and social studies, quantitative methods are used in controlled experiments or surveys and questionnaires (Blaikie, 2000). These methods may be appropriate in settings with tightly operationalised and clearly defined variables. However, they have limitations when used to collecting data related to processes and rich contexts such as those of complex university settings, especially when little is known about the phenomenon under investigation. Poorly understood organizational phenomena and systems need qualitative methods (Easterby-Smith et al., 2002). They are important to understand the in-depth processes especially when the study involves variables that do not lend themselves to experiments for practical or ethical reasons. They are also significant when the researcher would need to discover new or thus far unspecified variables.

In this study, the context of the institutional setting and the accounts of individuals (academics) are important. This dictates that “in situ” qualitative methods are more appropriate for the richness of the data required. Qualitative methods are best used when explanations are required to understand the complexity of interpretations and responses to contextual situations. The realist approach taken in this study seeks to understand and explain these realities.

#### **4.3.2.2 Nature of the research phenomenon and question**

To understand how implementation contributes to R&D success one needs to explore the phenomena of individuals and collectives (inter)actions and their relations in a given context (Easterby-Smith et al., 2002). The research question is “how do?” and not “how should?” which means that the study is exploratory in

nature and that cause-and-effect relationships are not required to solve the research problem (Perry et al., 1998).

As indicated earlier the interest here is to explore, describe, understand and explain events in R&D implementation leading to an outcome and not in the statistical correlations between levels of inputs (events) and outputs. For this purpose, qualitative exploratory research methodology seems most appropriate because it allows the development of a deeper understanding of a complex phenomenon (where input and output cannot be very accurately related) within its real-life context (Easterby-Smith et al., 2002). It opens up new ideas and interpretations of the research phenomenon. Hence, it is the right methodology to answer the “how” question of this study (Blaikie, 2000).

### **4.3.2.3 Influence of role of theory**

Qualitative methodology is especially useful for exploration of topics where the phenomenon is not well understood and where accepted theories have not been established or are clearly inadequate. In such cases the research requires inductive theory building because deduction from already existing principles of a “theory” is likely to be difficult (Easterby-Smith et al., 2002). Given that the purpose of this research is to build rather than test theory, as little previous research has been carried out about effects of implementation on the performance of R&D within academic context, qualitative exploratory methodology may thus lead to a more informed basis for theory building.

The goal of this research is to uncover themes, understand underlying mechanisms, and ultimately build theory (Blaikie, 2000). Exploratory studies act as a basis for theory development through grounded data analysis where themes emerge through data analysis (Eisenhardt, 1989). Having said that, this study recognises the importance of prior theory to proper research design (Blaikie, 2000). It uses an inductive/retroductive research strategy (Section 4.3.1) to accommodate both. A theoretical framework was developed from inductive literature review (Section 3.7). This framework is not a precise and

testable proposition (Patton, 1990) but can act as a general and broad research topic to view the effects of R&D implementation on its performance. As data collection begins, the researcher uses an inductive approach where whatever emerges from the data is considered. As the analysis proceeds, a more deductive approach to data analysis is used to verify the emerging themes (Patton, 1990). Exploratory research builds theories in the form of shaping propositions (Miles and Huberman, 1994).

As discussed earlier, the realism investigates the “objective” structures and events and the “subjective” meanings produced within that context to understand the studied phenomenon (Blaikie, 1995). Here, the researcher considers that how the actors (academics) behave depends very much on their perceptions of the events (implementation of R&D). The events, in turn, represent a set of structural conditions which determine the operation envelop for the actors. This envelop is also influenced by actors’ action.

The realist approach, as discussed earlier, attempts to discover the conditions underlying the causal mechanisms and structures and under which the actors’ behaviour can be expected to occur. Realist researchers obtain detailed knowledge about the processes underlying the behaviour in its contextual setting by means of empirical study. They observe the empirical domain by a “mixture” of concrete empirical research and abstract theoretical reasoning (Perry et al., 1998). Concrete empirical research deals with the actual events (effects of implementation on R&D performance) and treats them as phenomena that have been generated by specific mechanisms and structures. Abstract theoretical research (in this case exploring academic performance in view of strategy implementation concepts) deals with the mechanisms and structures (effects) that generate the events.

Concepts in realism are consistent with empirical findings. They inform empirical materials which are also informed by the existing literature. In this, theory is used to explain observations from the social world (Perry et al., 1998). Developing propositions and building theory from this exploratory research uses a comparison of the emergent themes with existing knowledge. It answers the

questions of what is similar, what is different and why, in an examination of both conflicting and informant literatures (Miles and Huberman, 1994).

In summary, this realist study compares the empirical evidence with the extant literature to clearly draw on its contributions. It then generalise these contributions within the scope of the research but not to a larger population. In this study, the logic used for theory building differs from positivist logic where more constrained and less detailed statistical generalisations are produced. It also disagrees with the logic employed by the interpretative approach where data are subjected to sociological theory or ideological position in order to make them meaningful (Easterby-Smith et al., 2002).

#### **4.3.2.4 Summary of the section**

This section has indicated that the logic of theory building in this study is a combination of inductive and retroductive strategies. The above discussion indicates that a qualitative approach to this research fits with both the ontological and epistemological preferences of the researcher. It is also in line with the nature of the phenomenon and the research question being investigated. The influence of implementation on R&D performance in universities is a complex and contemporary phenomenon. It requires exploration of a process in its context while theory building. Qualitative methodology provides “depth and detail” of the complexities of the research phenomenon through mapping the contextual nature of academic research. This methodology could help discover generative structures and put forward new propositions/concepts about relationships of implementation factors in university R&D in light of the new social view of science (Patton, 1990). Casell and Symon (1994) summarised the characteristics of the qualitative methodology:

- It focuses on the interpretation rather than the quantification of collected data.

- It emphasizes subjectivity rather than objectivity in the analysis process.
- It provides a degree of flexibility in the process of conducting research.
- Its orientation is towards the process rather than outcome.
- Its concern is with the context as behaviour and situation are linked in forming experience.
- It has an explicit recognition of the impact of the research process on the research situation.

## **4.4 RESEARCH DESIGN**

Designing research is about turning research questions into projects (Robson, 1993). It provides a link between the study question, the collected data and the conclusions drawn. Furthermore research design strategies can be classified into fixed, flexible or a combination of both (Robson, 2002). The traditional fixed design could be experimental, where the researcher changes the situation of participants on purpose to produce a change in their behaviour, or non-experimental, where the researcher observes only. The traditional flexible designs are the case study, which seeks in-depth knowledge about certain situations, ethnographic study which looks into various groups or communities' life, or grounded theory study which generates a theory. Real world research problems would generally involve multiple methods. The next sub-sections discuss the approach taken by this study to data collection and analysis. The quality of the research design is discussed at a later stage

### **4.4.1 Data collection**

Having decided to use a qualitative approach, discussion about how to obtain data suitable for such an approach is provided here. Qualitative data are non-numerical information collected by interviews, documentary records and observation. They are valid descriptions and interpretations of human actions based on in-depth, insider constructions of the life world of the

participants/respondents (Mouton, 1986). The process of collecting this type of data utilises the researcher's practical experience in his role in research administration in SQU, to understand research personnel and make sense of their experiences during face-to-face interviews.

Interviews are one of the most important sources of qualitative data. The depth and detail of qualitative data can only be obtained by becoming physically and psychologically closer to the phenomena through interviews (Kervin, 1992; Robson, 2002). Therefore they are very common instruments for qualitative data collection in exploratory researches (Kervin, 1992). They are suitable to obtain an individuals' understandings of their own experiences, and enable investigators to find out how these individuals arrive at their understandings (Easterby-Smith et al., 2002). In the assumed realist approach, interview technique assumes that the individuals reveal a true insight into their organizational and personal worlds outside of the interview situation. Most people are relatively comfortable with this format and enjoy talking about their work and lives which gives a unique richness of data. A possible disadvantage is that they can be time-consuming and produce a very large quantity of data.

Three types of interviews are described in the literature (Kervin, 1992; Robson, 2002). The first is structured interviews where the interview questions are predetermined with fixed wording in a pre-set order. The second is semi-structured interviews: In these interviews, questions are predetermined, but the order can be modified, wording can be changed and explanations could be given. Additional questions can be added or pre-set questions can be omitted with particular interviewees. The third is unstructured interviews in which the researcher has a predetermined area of interest but the interview can be completely informal.

Semi-structured interview-based survey was conducted to identify perceptions about success and otherwise as seen by individual researchers. In addition to those factors that attribute to success or otherwise. In this study the interviews were semi-structured to ensure a degree of consistency across interviews. However, they are flexible enough to allow the interviewer, to probe any areas

of particular interest, or to allow the interviewee to take the discussion in a direction most relevant to their experience and understanding.

#### **4.4.2 Sampling methods**

Samples in research can be classified into two categories; probability and non-probability samples (Kervin, 1992). Kervin provided the following sub-types under each category:

Probability samples:

- Simple random samples: Based upon random selection in the population.
- Systematic samples: Select every  $i^{\text{th}}$  case.
- Stratified samples: Divide population into groups or strata, and draw random samples from each.
- Cluster or multistage samples: Divide the population into clusters, which are naturally occurring sets of cases that are physically close together.

Non-probability samples:

- Convenience samples: Whatever cases are conveniently available close by.
- Self-selection samples: When the researcher allows the respondents to choose whether to take part in research.
- Snowball samples: The research begins with finding a few respondents in the target population, and the researcher asks them to suggest other cases that have similar characteristics.
- Judgement samples: The researcher selects cases relying on his own opinion.
- Expert samples: One or more experts help in selecting cases from the population.

- Quota samples: Researcher establishes quotas for the number of cases having certain characteristics.

Robson (2002) added another sub-type sample under the non-probability category:

- Dimensional samples: Various dimensions of the population thought to be of importance are incorporated in the sampling process.

Probability samples are selected randomly and have a known probability of selection. In addition their contributions are reweighted back to their true proportions which produce statistical representations. This strategy is suitable for hypothesis testing. Qualitative research, however, seeks to underpin a phenomenon, in depth as well as in breadth. Extract needs only to appear once to be of value. Therefore qualitative methodology uses, mostly, non-probability sampling techniques as it is not interested in a statistically representative sample or to draw statistical inferences. The number of cases sampled in this methodology is often small. The analysis of large numbers of in-depth interviews would simply be unmanageable because of a researcher's ability to effectively analyse large quantities of qualitative data.

The iterative nature of the theoretical sample design is important. It gives the researcher the opportunity to analyse the data as the sampling progresses and means that the researcher can add to or change the emphasis of the sample design, and in so doing ensure robustness of the theories generated. It is therefore valuable to have considered the analysis technique early on in relation to the qualitative sampling strategy.

Because of the exploratory nature of this study, grounded data analysis approach is assumed, see Section 4.4.5. In this, themes are generated, through an iterative process, involving the continual sampling, collection and analysis of data to inform the next stage of the sample design. This process goes on until "data saturation" is achieved; that is, no new ideas or theories emerge from further data analysis. Data collection is controlled by the emerging themes, thus



the specific focus of grounded data analysis approach on theory generation adds an important dimension to data collection in this study.

#### **4.4.3 Interviewees**

The selection of interviewees was random to ensure that there was no bias towards particular kinds of backgrounds or speciality. A list of all active researchers in SQU was obtained from an electronic database, at the Research Department, which precluded internal bias. The list included names of active researchers from seven Colleges; College of Arts, College of Education, College of Commerce and Economics; College of Science, College of Engineering, College of Agriculture and Marine Sciences and College of Medicine. The only obvious lack of representation in the interviewees was the lack of representatives from College of Law. This lack was because no member of the College Law was inactive in research. Their contribution would not have been useful to this study as it targets the experiences and values of active researchers gained from SQU funded research.

To prohibit external bias, software named “SuperCool Random Number Generator” was used to randomly select interviewees' names. The list produced by the software provided a good cross-section of researchers' backgrounds covering all academic Departments and Colleges active in research. Wilmot (2005) suggested using 20 to 50 interviews in exploratory qualitative studies, depending on the research question. Number of interviews in this study, selected at the time of the random sampling, was 25.

Using a concept of theoretical sampling grounded data analysis, “data saturation” was achieved after conducting 12 interviews, that is no new extracts appeared in the analysis. Further interviews confirmed this conclusion, and the interviews were stopped after reaching a total of 22. Of these 22 interviews, six came from a Social Science (SS) background, seven from Basic Sciences (BS) and nine from Applied Sciences (AS). SS covered three Colleges; College of Arts, College of Education and College of Commerce and economics. BS and

AS came from four colleges depending on the department; College of Science, College of Engineering, College of Agriculture and Marine Sciences and College of Medicine. Out of the 22 academics interviewed eight were Full Professors (FP), eight were Associate Professors (AP) and six were Assistant Professors (AP). Thirteen of these academics have had experience in administration and nine of them lacked this experience. Summary of interviewees list is provided in (Table 4.3).

<b>Interviewee no.</b>	<b>Nature of science</b>	<b>Rank</b>	<b>Admin experience</b>
01	AS	AP	LAE
02	AS	FP	AE
03	AS	FP	AE
04	SS	MP	LAE
05	SS	AP	LAE
06	AS	FP	AE
07	SS	FP	AE
08	SS	MP	LAE
09	BS	FP	AE
10	BS	FP	AE
11	SS	MP	AE
12	AS	MP	AE
13	AS	FP	AE
14	BS	FP	AE
15	BS	MP	LAE
16	AS	MP	LAE
17	BS	AP	LAE
18	BS	AP	LAE
19	AS	AP	AE
20	AS	MP	LAE
21	BS	AP	AE
22	SS	MP	AE

Table 4.3: List of interviewee. AS: Applied Science, SS: Social Science, BS: Basic Science, FP: Full Professor, MP: Associate Professor, AS: Assistant Professor, AE: Administration Experience and LAE: Lacking Administration Experience.

Unfortunately no more details on the candidates can be provided because the interviews took place under an agreement that anything said could be quoted but confidentiality of source was guaranteed, both in terms of the individuals and the individual's department.

#### **4.4.4 Conduct of interviews**

Preliminary contact was made by telephone with each interviewee to seek their approval to conduct an interview. All approached academics agreed to participate in the study. Then a letter was electronically mailed to each interviewee before a second call was made to arrange a specific date, time and location for the interview. Interviews were conducted at the participants' offices.

The pre-prepared interview questions turned out to be helpful only as general guidelines. As the interviewees were briefed in the letter sent to them and briefed again before the start of the interview about the purpose of the research, they needed little prompting during the interviews. In most cases, the discussion started even before the start of the formal interviews and went much beyond these initial guides. The interviews were digitally recorded to facilitate further analysis.

As the nature of the interviews was exploratory, questions were asked according to the flow of the discussion keeping in view the objectives, instead of following the prompt sheet. This flow was enriched by the researcher's experience in the administration of the projects discussed.

The questions of the interviews were developed and pilot tested on two interviewees. As a result of these two pilot interviews, it was noted that the proposed interview structure worked well, with the exception of some phrases and order of some questions. For example, asking the interviewees direct questions about success and failure, at the beginning, did not help to extracting their experience and beliefs of what led to success or otherwise. This could have been because it is human nature is to be defensive when an individual believes they are under attack, although the purpose of the interviews had been

explained to them. Rather, the interviewees were asked to speak about their research experience and projects they had been and currently were involved in, specifically at SQU, then to select a successful research project of their own to talk about. At a later stage the interviewees were asked to speak about a research project which they thought was not successful. This revealed better results, as been witnessed in the interviews, in terms of extracting participants' experiences. After modification, a final interview schedule of questions was completed. Interviews took place at SQU in the interviewees' offices.

### **4.4.5 Data analysis**

Bernard (2002) defined the process of analysing data as the search for similar patterns and ideas. He also thought that the analysis needs to explain why those patterns existed in the first place. He explained that qualitative data can be analysed quantitatively, where words and images are turned into numbers, or qualitatively, where texts and transcripts are interpreted. In this study both types of analysis are used.

#### **4.4.5.1 Approach used in data analysis**

Content analysis and grounded data analysis are commonly used for qualitative analysis (Easterby-Smith et al., 1991; Bernard, 2002). Content analysis is useful to prove or disprove a certain theory, but the grounded theory is more open and useful to develop a theory that is grounded in the data. In both approaches a set of techniques are used for identifying emerging categories or concepts from a text and linking these categories into substantive and formal theories. The emerging categories could be generated inductively and/or deductively.

Punch (1998) named three main components for analysing qualitative data; data reduction, data display, and drawing and verifying conclusions. Data reduction refers to the process of selecting, focusing, abstracting and transforming the data. Data display refers to an organised, compressed assembly of information that permits conclusion drawing. These are done

through two operations; coding and memoing. Coding is the process of putting tags, names or labels against pieces of data. Memoing is the writing up of ideas about codes and their relationships as they strike the analyst. These two operations cover data reduction and display that leads to drawing conclusion and verifying stage. The software Nvivo helps achieving these objectives. The software assesses building structure of nodes, relation's memos between those nodes and modelling. It also runs comparison between sources of evidence and nodes.

#### **4.4.5.2 Analysis of the interviews**

Inductive/retroductive grounded approach was used to analyse interview's transcripts. Analysing the transcript is a tool used to breakdown speeches, records, and other written communications to determine key ideas, themes, words, or other messages contained in the record (Adams and Schavaneveldt, 1985).

As highlighted earlier, this research is exploratory rather than explanatory. The semi-structured interviews could result in factors being repeated due to the flow of conversation, it was decided that only existence would be counted in a particular interview and not frequency of recurrence. On the other hand, frequency would be counted across interviews which could give an indication of the importance of the coded factor and/or measure at this stage. Counting of extracts allows for the weighting and ordering of qualitative data (Lee, 1999). This is particularly useful when dealing with the number of success measures and attributes to this success.

In this study, a computer assisted qualitative data analysis software tool NVivo 8.0 was used in the first instance to carry out a complete coding of the data (Bazeley, 2007). Two processes were used to analyse the data thematically; open coding and axial coding. Next sub-sections discuss these processes in detail.

##### **4.4.5.2.1 Open coding**

Open coding is the first stage in the process of qualitative analysis to bring together data and ideas. During the process of open coding, the researcher identifies and tentatively names emergent conceptual categories (Hussey and Hussey, 1997). The aim is to create descriptive, multi-dimensional categories to form a preliminary framework for analysis. Words, phrases or events that appear to be similar can be grouped into the same category. These categories may be gradually modified or replaced during subsequent stages of analysis.

In this study, the open coding process was used to reduce the data into conceptual categories or themes of R&D success measure and technical and behavioural effects of implementation on R&D performance. The emphasis in this grounded data analysis approach is to derive meaning as perceived and described by the interviewees. In this process, similar statements or extracts were grouped under a “Node” as seemed relevant. Each “Free node” formed either a success measure or an implementation effect. Strauss and Corbin (1994) recommended using terms that emerge from the data rather than using terms that are found in existing literature. However, this study takes an inductive/retroductive approach in its investigation. The categories were formed from the emergent codes in the data but they were contextualised into a theme that emerged from the literature (Easterby-Smith et al., 2002).

### **4.4.5.2.2 Axial coding**

Axial coding is the next stage of the analysis process of the interview’s transcript. It involves re-examination of the categories identified to determine how they are linked (Easterby-Smith et al., 2002). The purpose of the axial coding process is to acquire an understanding of the “bigger picture” of the phenomenon in addition, of course, to describing it. In this study the axial coding process was generally used on completion of the open coding process, but sometimes simultaneously. The relationships between the emerged categories of measures and effects were examined. This process has created a bottom up hierarchy where free nodes (from open coding) are grouped together based upon their relationship with the emergence of sub-categories. A structure (tree) of nodes was formed as data analysis progressed and two lists

(structures) of effects and measures resulted. Codes (sub-categories) were titled as seemed relevant to the prior theory (Easterby-Smith et al., 2002).

#### **4.4.5.2.3 Finding presentation**

The findings of this study are described in the structure of categories. Each category, measure and factor, of both structures forms an emerging theme. Further distribution analysis was used to describe the findings in terms of interviewee groups. Distribution analysis technique refers the extracts obtained to their interviews. It also provides what frequency each extract has in terms of the interviewee groups, and highlights statistical comparison between categories. Seven categories (themes) for success measures, and five for success factors have emerged. A summary table of the findings was developed to assist in cross-referencing data to specific interview.

Figure 4.1 shows the layout used to present the results of this study. Hussey and Hussey (1997) stressed that in qualitative studies, it is difficult to separate analysis from results and, often, one needs more than one chapter to do that. Further and as indicated earlier, the findings of this study are either measures of R&D performance or effects of implementation of R&D performance. Because of the different nature of the findings, it was thought wise to separate them during the presentation of findings and integrate them back during discussion at a later stage. Chapter five discusses the findings related to measures of success of publicly funded academic research, whilst chapter six presents the results of implementation effects on performance of publicly funded academic research.

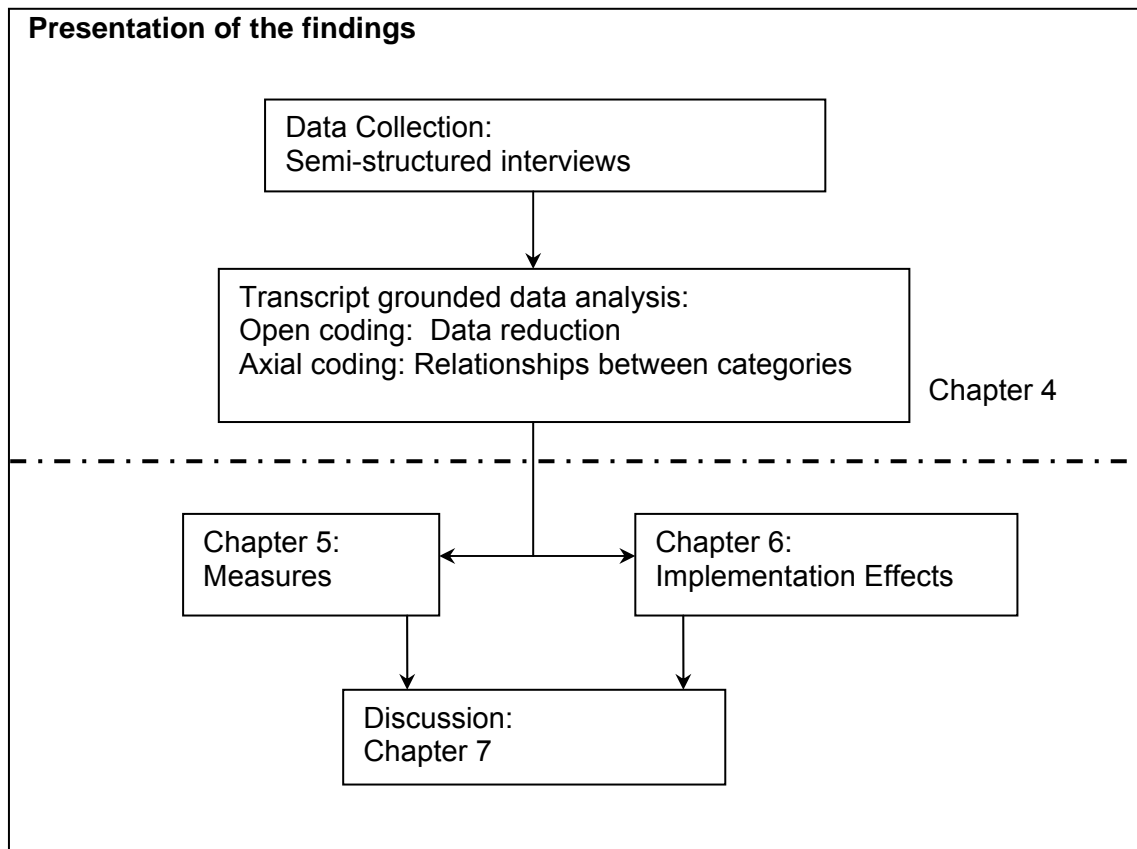


Figure 4.1: Layout for presentation of the findings.

#### 4.4.6 Summary of the section

This section highlighted the research design for this exploratory qualitative study. Interviews are commonly used for data collection in exploratory qualitative researches (Kervin, 1992) and here 22 semi-structured interviews were used to collect data. The interview eases the obtaining of an academic's understandings of his/her own experiences and how he/she arrived at these understandings (Easterby-Smith et al., 2002).

As a first stage, the software "**SuperCool Random Number Generator**" was used to select, randomly, 25 interviewees from a list provided by Research Department at SQU. Only 22 interviews were conducted. The inductive/retroductive grounded data analysis showed that the first 12 interviews provided all the findings in this study.



## 4.5 RESEARCH QUALITY

In general terms, quantitative research seeks causal determination, prediction and generalization of findings. However, qualitative research seeks to illuminate, understand and extrapolate to similar situations (Lincoln and Guba, 1985). This interpretative exploratory research brought out a substantial quantity of rich interview data related to effects of implementation on academic R&D performance. In this type of research the interpreter is central to any understanding of the social knowledge that emerges. Self awareness has been essential in order to counter the possible influence of personal bias throughout the research. A process of self-reflection has preceded and occurred throughout all stages of the research design and execution.

Further, the quality of a study should be judged by the terms of its philosophical paradigm (Healy and Perry, 2000). The quality of research is often described in the positivist terms of validity, reliability and generalisation of findings. The meanings of these terms depend on the philosophical paradigm, see Table 4.4, (Easterby-Smith et al., 2002). The quality of realism research uses a blend of the criteria that have been developed for positivism and/or interpretivism. The quality of positivist quantitative research depends on instrument construction for testing. The credibility of this test is to ensure replicability or repeatability of the result. Quantitative positivist researchers use validity and reliability to refer to research credibility. In Interpretivism qualitative research they are viewed together with the use of different terminology that encompasses both, such as trustworthiness and credibility (Lincoln and Guba, 1985).

Reliability in positivism corresponds to dependability, audit-ability, credibility/authenticity, contingent validity and consistency in realism (Healy and Perry, 2000). All these set criterion for internal validity or data trustworthiness. Positivist generalisation is related to “analytic generalisation”, external validity or transferability in realism (Easterby-Smith et al., 2002).

	<b>Positivist</b>	<b>Relativist</b>	<b>Constructivist</b>
<b>Validity</b>	Do measures correspond closely to reality?	Have a sufficient number of perspectives been included?	Does the study clearly gain access to the experiences of those in the research setting?
<b>Reliability</b>	Will the measures yield the same results on other occasions?	Will similar observations be reached by other observers?	Is there transparency in how sense was made from the raw data?
<b>Generalisability</b>	To what extent does the study confirm or contradict existing findings in the same field?	What is the probability that patterns observed in the sample will be repeated in the general population?.	Do the concepts and constructs derived from this study have any relevance to other settings?

Table 4.4: Perspectives on research quality in different philosophical stances, (Easterby-Smith et al., 2002)

The quality or trustworthiness of this realist, exploratory, qualitative and inductive/retroductive grounded data analysis research is ensured through two main elements. The first is consistency (dependability, audit-ability, credibility, authenticity or contingent validity) and the second is data trustworthiness or internal validity. Because of the exploratory nature of this study generalisation is not intended. Therefore generalisation has not been given heavy emphasis in the discussion. The following sub-sections discuss these elements in details.

#### 4.5.1 Consistency

Lincoln and Guba (1985) used “dependability”, “consistency” or “audit-ability” instead of “reliability”. Consistency or reliability can be defined as the extent to which the measuring procedure yields the same results on repeated trials (Neuendorf, 2002). To enhance the consistency of qualitative research Lincoln and Guba (1985) suggested the use of an “inquiry audit”. This examines both the process and the product of the research in terms of *Stability*, (intra-rater) and *Reproducibility* (inter-rater). While the former answers the question can the

same coder get the same results try after try? the latter answers the question can two different coders arrive at the same result? (Stemler, 2001).

The process of consistency testing could be achieved by selecting a number of recorded interviews randomly and re-analysing them by the researcher himself to achieve the intra-rater test. The inter-rater consistency can be reached by asking another expert (second rater) to apply the same analysis techniques to derive categories independently for a number of interviews. Then both the researcher's results and the rater's are compared (Gale and Grant, 1990). This approach was thought to be fruitful for this research.

#### **4.5.1.1 Stability audit**

To ensure intra-rater consistency, the content analysis process was repeated by the researcher on two randomly selected interviews. The replication revealed the same result which ensures the intra-rater consistency.

#### **4.5.1.2 Reproducibility audit**

In order to ensure that the analysis carried out by the researcher were consistent, an inter-rater audit was conducted on two randomly selected interviews. The second rater was an administrative staff member in SQU. He was familiar with research administration and the purpose of the research was explained to him. The coding rules were explained to him in detail, in addition he was given on-the-job training through numerous examples.

The results of the consistency tests are given in Table 4.5, which shows that the inter-rater consistency was quite high, although the researcher found one more factor than the second rater in the second test interview. This could be attributed to the higher involvement of the researcher in the research and the interviews than the second rater.

No of test interview	Researcher		Second rater	
	No of factors	No of measures	No of factors	No of measures
1	20	8	20	8
2	17	5	16	5

Table 4.5: Results of the inter-rater consistency tests.

#### 4.5.1.3 Random sampling

Random sampling of informants may negate charges of researcher bias in the selection of participants (see Section 4.4.2). Random sampling ensures that any “unknown influences” are distributed evenly within the study sample (Shenton, 2004). It is particularly appropriate to the nature of the “collective case study” investigation where multiple voices, exhibiting characteristics of similarity, dissimilarity, redundancy and variety, are important to gain greater knowledge of a wider group, rather than selected informants.

#### 4.5.1.4 Triangulation of data sources

Triangulation may involve the use of different methods for data collection such as observation, focus groups and individual interviews (Patton, 1990). It may also involve the use of a wide range of informants or triangulation of data sources (Healy and Perry, 2000). Consequently comparison of data described by one interviewee becomes possible with those provided by others in a comparable position. An individual’s viewpoints and experiences are verified against others and, ultimately, a rich picture of individual behaviour may be constructed based on the contributions of a range of people (Shenton, 2004).

In this study, triangulation of data sources was used. The interviewee sample covered three classifications of science (Social, Basic and Applied), three ranks of interviewees (Full Professors, Associate Professors and Assistant Professors) and interviewees with and without administration experience.

## **4.5.2 Internal validity**

In explanatory positivist studies, internal validity addresses how well cause and effect relationships are justified, and sources of bias are eliminated. In exploratory realist studies such as this thesis, internal validity can be conceptualised as the extent to which inferences are sufficiently grounded in the data. Validity as seen here should answer the question; have a sufficient number of perspectives been included? (Easterby-Smith et al., 2002). The aim of realism research is to discover knowledge of the real world by naming and describing broad, generative mechanisms that operate in the world (Healy and Perry et al., 1998). The desire of realism research is to develop a “family of answers” that cover several contingent contexts and different reflective participants (number of perspectives been included as seen by Easterby-Smith et al., (2002). Realism affirms that truth about a “family of answers” that can be known, albeit imperfectly. Validity is about generative mechanisms and the contexts that make them contingent (Healy and Perry, 1998) which has been the output from this study.

Furthermore, in order to align the concepts being studied with the evidence being observed, the processes of data collection and analysis are described in detail. The findings are backed up by numerous references, including quotations from informants, and summaries presented throughout the main body of the thesis and in the appendices.

### **4.5.2.1 Trustworthiness of collected data**

Interviews are very common instruments for qualitative data collection in exploratory research (Kervin, 1992). The depth and detail of qualitative data can only be obtained by ensuring the trustworthiness of data obtained (Kervin, 1992; Robson, 2002). In this thesis to ensure trustworthy data was provided by interviews, participants were encouraged to be frank from the outset of each interview. From the opening moments, it was indicated that there are no right answers to the questions that would be asked. Confidentiality of data sources

was ensured so that participants could contribute ideas and talk freely of their experiences without fear.

Some tactics, such as probing, call back or iterative questioning, could be used to uncover deliberate lies (Kvale, 1996). Researchers return to matters previously raised by interviewees to extract related data through rephrased questions. In the cases of contradictions, researchers may decide to discard suspect interviews (Shenton, 2004). During interviews in this study, probes and iterative questioning were used to elicit detailed data.

Negative case analysis is a form to ensure the trustworthiness of data provided by interviews (Lincoln and Guba, 1985; Miles and Huberman, 1994). In exploratory studies where the conclusion is proposition development, such as the one in hand, the researcher may include the discussion of negative experiences (in addition to positive ones) during the personal interviews. This allows the researcher to compare the data provided by the two and identify any contradictions. In this study, the interviewees were asked to speak about two projects; one successful and the other unsuccessful.

### **4.5.3 Generalisation**

From positivist ontology, generalisability (or external validity) answers the question; to what extent the findings can be generalised from the study sample to the entire population. This view, however, has little relevance to the principles and goals of realism. The concern, here, is with gaining a comprehensive understanding of the underlying mechanisms and structures of the phenomenon.

Easterby-Smith et al., (2002) argued that generalisation of research refers to the traditional external validity. Generalisation may be derived from one of three bases (Kvale, 1996): naturalistic (personal experience), statistical (formal and explicit and use of confidence intervals) and analytical (reasoned judgement and consideration of the similarities and differences between two situations). This research, subscribes to the principle of generalisability outlined above

seeking “analytical generalisation” rather than statistical representativeness. In so doing this study contributes to theory building rather than theory testing. It develops a theoretically-informed and empirically-supported conceptualisation of effect of implementation of R&D performance aided by in-depth access to the field setting.

#### **4.5.4 Summary of the section**

In this section the quality of this research was discussed. The quality of this realist research is emphasised by self awareness that encountered possible personal bias. In addition that a sufficient number of perspectives emerged from data analysis brought contingent validity to the study. Intra-rater and inter-rater tests showed decent reliability/dependability of this study. This research acknowledges that generalisations derived from realist research hold probabilistic truth not absolute truth as it assesses the phenomenon in the empirical domain (Easterby-Smith et al., 2002). Some aspects to the generalisation of the findings related to the effects of implementation on R&D performance have been addressed in this section.

### **4.6 CHAPTER SUMMARY**

This exploratory study attempts to gain a deeper understanding of implementation effects on the performance of academic research. A grounded data analysis approach was used to develop ideas and constructs as they flowed from the research data, whilst prior theoretical models and hypotheses were used to explain observations from the social world (Perry et al., 1998).

Realist ontological and relativist epistemological assumptions of this research justified qualitative, interpretive research. An inductive/retroductive research strategy fits with the philosophical assumptions and grounded data analysis approach. The third section considers the data collection methods and analysis tools used. Before that, however, readers were reminded of the research question.

The qualitative research methodology used 22 semi-structured interviews to collect data. The distribution of interviewees' backgrounds covered most SQU colleges. The grounded theory approach was used to analyse the data collected. The inter-rater test showed similarity between the researcher's findings and the second rater. The case for limitation of generalisability of this research was argued at the end of the chapter. Next chapter discusses the finding of this study in detail.



## 5 FINDINGS: SUCCESS MEASURES

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### 5.1 INTRODUCTION

To remind the reader, the aim of this study is to establish, empirically, the effects of R&D implementation on R&D performance in SQU. The study also intends to find out what measures could be used to influence the performance of academic research in light of the social view of scientific knowledge. As discussed in chapter four, detailed qualitative data analysis found twelve themes; seven success measure and five implementation effects. The measures of success are “**Standard measures of project success**”, “**Knowledge production**”, “**Educational contributions**”, “**Capacity building**”, “**Institutional economic benefits**”, “**Policy benefits**” and “**Broader social benefits**”. The implementation effects are “**Strategy related effects**”, “**Task/Project related effects**”, “**Team related effects**”, “**Organisational effects**” and “**Behavioural effects**”. It was thought wise to separate the findings of success measures from the implementation effects for simplicity. This chapter presents the findings of success measures and chapter six discusses the effects of implementation.

The structure of this chapter is based on emergent themes. This includes a list of 18 sub-themes or measures and the distribution of these measures into categories. Distribution analysis also shows what results were obtained from which interview group.

### 5.2 PRESENTATION OF THE FINDINGS

Using grounded theory approach (Section 4.6.4) data was thematically analysed. Similar statements or extracts were grouped under a “Free Node” as seemed relevant to form a measure (open coding process). As the interviews progressed, the number of new emerging measures decreased because many

of them had already been introduced at previous interviews. “Data saturation” occurred after the seventh interview, see Figure 5.1. The rest of the interviews emphasised the measures that were identified by the first seven interviews. The study, therefore, claims that all possible measures have been found and that the “completeness” of measures developed is robust.

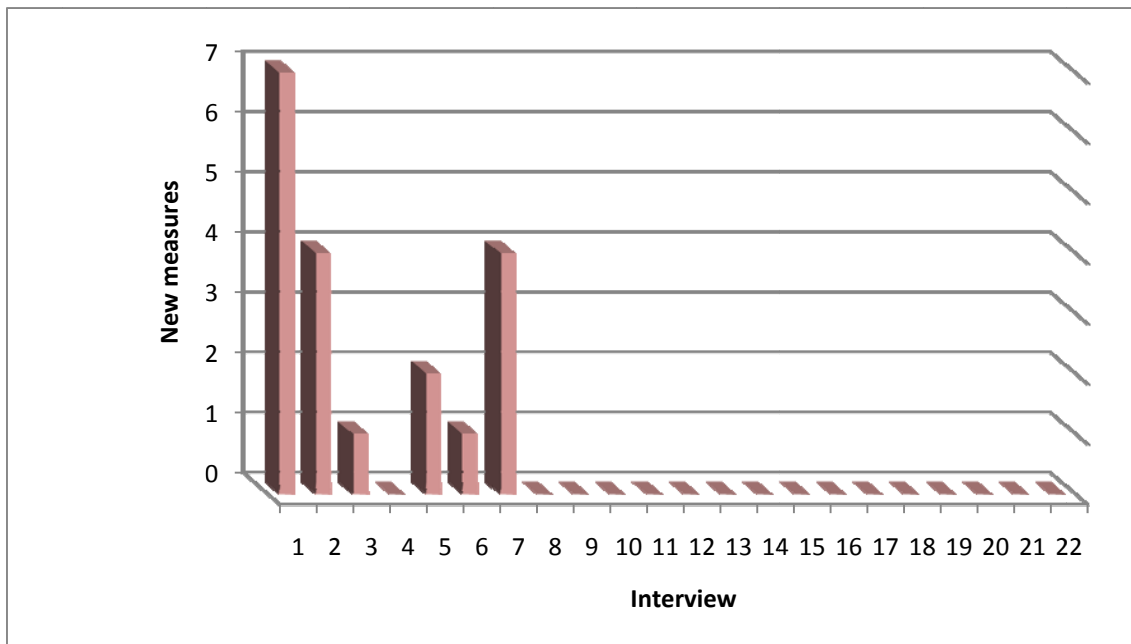


Figure 5.1: Number of emerged new measures from interviews

On completion of the open coding process, and sometimes simultaneously, an axial coding process was used to examine the relationships between the emerged “Free Nodes” (for more details see chapter 4). This is a bottom up hierarchy where the free nodes were grouped together based upon their relationship. A structure (tree) of nodes formed as data analysis progressed and seven categories resulted.

The findings of success measures were then analysed using distribution analysis techniques which show what result was obtained from which interview. It also provides the frequencies of each finding in terms of the following distribution groups (see chapter four for detail of interviewee distribution):

- nature of science of the interviewees; “Basic Sciences” (**BS**), “Applied Sciences” (**AS**) and “Social Sciences” (**SS**),

- rank of interviewees; “Full Professor” (**FP**), “Associate Professor” (**MP**) and “Assistant Professor” (**AP**), and
- interviewees’ “Administration Experience” (**AE**) or lack of it (**LAE**)

The analysis also shows distribution of extracts into categories and a simple statistical comparison between categories is provided.

### **5.3 FINDINGS FROM THEMATIC ANALYSIS**

In light of the latest social contract for science (see Section 2.2.2), successful performance of academic research may mean different things to different people. An objective of this project was to define a list of success measures for university research. Most of the respondents stated that research, by its educative nature, is successful. This, in itself, is highly significant because it implies that their thinking was restricted by an unconscious assumption of this view of success, or that they had not thought about the matter in light of the social view of science. Having said that, the distribution analysis (Section 5.4) of the results shows that all interviewees contributed, although not to the same degree, to the conclusion of the measures identified.

Data thematic analysis, for success measures, revealed a list of 18 measures (Table 5.1). This section describes the findings of success measures in detail. It provides quotations from interviews for each identified success measure. The description is structured based on the category classification presented in Section 5.3.1. These categories specify the emerging themes from this study.

## Findings: Success Measures

No.	Measure	Interview number																					Frq.	
		1	2	3	6	12	13	16	19	20	4	5	7	8	11	22	9	10	14	15	17	18		21
<b>Standard measures of project success</b>																								
1	Delivery of promises			√		√		√		√					√						√	√		7
2	Completion on time	√				√		√				√		√	√			√			√			8
3	Completion within budget							√				√		√	√									4
4	User satisfaction	√												√	√									3
<b>Knowledge production</b>																								
5	New knowledge		√		√	√							√			√								5
6	Scientific publication	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	√	22
<b>Educational contributions</b>																								
7	Curriculum Improvement		√		√					√	√	√			√		√	√				√		9
8	Student employment enhancement		√		√			√	√			√		√							√	√	√	10
<b>Capacity building</b>																								
9	Contributions to intellectual capacity	√	√	√	√	√					√	√		√	√						√			10
10	Contributions to R&D infrastructure		√		√	√			√			√	√					√				√		8
11	Contributions to institutional reputation	√	√		√			√	√	√				√		√		√			√	√		14
<b>Institutional economic benefits</b>																								
12	Industrial linkages											√	√		√									3

**Effects of R&D Implementation on the Performance of Publicly Funded Research in SQU**

No.	Measure	Interview number																				Frq.		
		1	2	3	6	12	13	16	19	20	4	5	7	8	11	22	9	10	14	15	17		18	21
13	Research income	√			√	√					√	√						√	√				7	
14	Income from IP & product								√	√		√	√	√	√		√	√	√		√		10	
<b>Policy benefits</b>																								
15	Policy modification						√				√		√		√	√				√			6	
16	Input to national plans	√										√				√							3	
<b>Broader social benefits</b>																								
17	Cultural contributions				√		√	√		√		√	√	√	√	√		√		√		√	12	
18	Technical contributions	√	√	√	√			√	√	√		√	√		√					√		√	12	
<b>Total</b>		<b>8</b>	<b>8</b>	<b>4</b>	<b>10</b>	<b>7</b>	<b>4</b>	<b>8</b>	<b>6</b>	<b>5</b>	<b>2</b>	<b>7</b>	<b>13</b>	<b>10</b>	<b>7</b>	<b>14</b>	<b>6</b>	<b>3</b>	<b>7</b>	<b>4</b>	<b>7</b>	<b>8</b>	<b>5</b>	<b>153</b>

Table 5.1: List of the 18 success measures as found empirically. Columns in light colours show interviewees from Social Sciences while dark ones represent interviewees from Basic Sciences. Clear columns show Applied Sciences.

### 5.3.1 Emergent themes: categories of measures

As explained in Section 4.4.5.2.1, the study uses inductive/retroductive research strategy. The categories were formed from the emergent codes in the data but they were contextualised into the theme that emerged from literature (Easterby-Smith et al., 2002). It was discussed in chapter three that HERG’s payback model (Buxton and Hanney, 1994 Hanney et al., 2004) was considered a base from which to view the performance of academic research. This model is used to measure the performance of publicly funded NHS research in the UK (see Section 3.3). HERG’s model uses the following structure to categorise research payback measures; “**Knowledge production**”, “**Future research, capacity building and absorption**”, “**Informing policy and product development**”, “**Health sector benefits**” and “**Broader economic benefits**”. A similar structure, but in different words, is used in Table 5.2 to categorise the measures found here.

No.	Structure in this study	HERG payback model
1	Standard measures of project success	.....
2	Knowledge production	<b>Knowledge production</b>
3	Capacity Building	<b>Future research, capacity building and absorption</b>
5	Educational contributions	.....
4	Institutional economic benefits	<b>Broader economic benefits</b>
6	Policy benefits	Informing policy and product development
7	Broader social benefits	<b>Health sector benefits</b>

Table 5.2: Comparison between categories of success measures found by the study in hand and that of HERG’s payback model

Following HERG’s model most of the measures in this study, were allocated to “**Knowledge production**”, “**Capacity building**”, “**Institutional economic benefits**”, “**Policy benefits**” and “**Broader social benefits**”. However, six measures such as “*On time completion*” and “*Delivery of promises*” could not be

allocated to these categories because of their nature. Other works in the literature of Higher Education, MTA and ITA suggested two additional categories; “**Educational contributions**” (Arnold and Balázs, 1998; Langford et al., 2006), and “**Standard measures of project success**” (Jawad, 1995; Mallon, 2002). These two categories accommodated the six measures and the total number of success categories became seven. Section 5.4.3 discusses the distribution of identified measures in these categories (themes) which are used to structure the discussion of the finding in this section.

**5.3.2 Category one: standard measures of project success**

Standard measures for project success reflected common criteria for measuring performance of research projects. The standard measures of success set minimum criteria for performance evaluation when other R&D achievements add value to the project. Total extracts in this category were 22. The thematic analysis of these extracts provided four success measures; “*Delivery of promises*”, “*Completion on time*”, “*Completion within budget*” and “*Users satisfaction*” (Table 5.3). References to this table are provided as the description flows.

Standard measures of project success	Extracts	Extracts by Nature of science			Extracts by Rank of researchers			Extracts by Administrative experience	
		SS N= 6	BS 7	AS 9	FP 8	MP 8	AP 6	AE 13	LAE 9
Delivery of promises	7	1	2	4	1	4	2	3	4
Completion on time	8	3	2	3	1	5	2	4	4
Completion within budget	4	3	0	1	1	3	0	3	1
User satisfaction	3	2	0	1	0	2	1	2	1
<b>Total</b>	<b>22</b>	<b>9</b>	<b>4</b>	<b>9</b>	<b>3</b>	<b>14</b>	<b>5</b>	<b>12</b>	<b>10</b>

Table 5.3: Distribution of extracts in the category “Standard measures of project success” based on different interview groups.

### 5.3.2.1 Measure 1: delivery of promises

R&D projects delivered certain promises and objectives, as outlined in approved proposals. Among SQU research staff it was believed that performance of research projects was measured by the achievement of their objectives.

*"{The project} was not finished successfully because we did not achieve the goal... to be able become successful it has to achieve the goals". (Interviewee, 12)*

*"Researcher is putting some targets, some objectives to be achieved, if these objectives have not been achieved, then the project is a failure". (Interviewee, 17)*

To interviewees success of R&D meant delivery of promises. The HERG payback model overlooked this measure but Pilbeam (2002) found that "Non delivery of output in time or budget" was a characteristic of less successful projects.

The measure "Delivery of promises" scored 7 (32%) out of the 22 extracts in the category "**Standard measures of project success**" (Table 5.3). Interviewees from all groups identified this measure which reflects its importance in evaluating academic research.

Most of the interviewees linked the measure "Delivery of promises" to the measures "Completion on time" and "Completion within budget". These are discussed in the next section.

### 5.3.2.2 Measure 2 and 3: completion on time and within budget

Although "Completion on time" and "Completion within budget" are two separate measures, they are discussed here together because the interviewees tended to combine them. Interviewees emphasised that research objectives should be achieved within an agreed time and budget for the project to be considered successful. For example, where a team promised to deliver research objectives



on an agreed timeframe, they had to deliver as per the conditions of the proposal. The project would be successful because they

*“deliver it on time”. (Interviewee, 16)*

Success of R&D projects depended on the achievement of objectives in the given conditions of time and budgets.

*“Research to be considered successful should achieve the objectives it promised and if these objectives were agreed upon at front; the project is successful... One of the indicators for success is to finish what you promised to do on time and at the agreed cost”. (Interviewee, 22)*

*“We have the proposal, you indicate what you would like to achieve with the objectives, and you see whether I have really achieved it or not in terms of time schedule”. (Interviewee, 18)*

To emphasize these measures a more proactive perspective was suggested. Incentives for completion on time and within budgets were thought to encourage academics to stick to their research plans. The argument was that

*“researchers should be given a reward like 10% of the project cost if they finish in time and within budget”.(Interviewee, 11)*

Successful projects delivered their promises within approved timeframes and budgets. The measure *“Completion within budget”* was overlooked by HERG. Jawad (1995) and Mallon (2002) found that *“Completion on time”* and *“Completion within budget”* were two of the measures used to assess technology acquisition projects.

The measures *“Completion on time”* and *“Completion within budget”* scored, respectively, 8 (36.4 %) and 4 (18.2 %) out of the 22 extracts in the category **“Standard measures of project success”** (Table 5.3). Interviewees from all groups identified the measure *“Completion on time”* which reflects its importance to performance measurement of academic research. The measure *“Completion within budget”* was mentioned by only one of the thirteen

interviewees in the AP and BS groups. BS researchers may be less concerned with budget limitations as they do not use a customer-client relationship.

#### 5.3.2.3 Measure 4: user satisfaction

The study found that among SQU research staff it was believed that successful research projects satisfied their end users and satisfied end users fund more research in the future which makes it of significance when considering research evaluation.

*“One SME company had to modify their code of practice, they were doing things that they were not suppose to, I cannot tell you more details as they do not allow us to. Now they have improved and we got more work with them due to the confidence we gained”. (Interviewee, 22)*

*“The agencies to whom we planned to outreach, to whom we planned to extend our researchers are satisfied”. (Interviewee, 14)*

This finding supports previous R&D work that successful research projects satisfied their end-users (see Pinto and Slevin, 1987; Balachandra and Friar, 1997; Jawad, 1995; Mallon, 2002; Goffin and Mitchell, 2005; Ottenbacher et al., 2006).

The measure *“User satisfaction”* scored 3 (13.6 %) out of the 22 extracts in the category **“Standard measures of project success”** (Table 5.3). Unlike other groups, FP and BS groups appeared unconcerned with this measure. BS do not deal with end-users as much as AS and SS researchers.

#### 5.3.2.4 Summary of category one – theme 1

Thematic analysis of 22 extracts in the category **“Standard measures of project success”** found four success measures; *“Delivery of promises”*, *“Completion on time”*, *“Completion within budget”* and *“Users satisfaction”*.

Successful research projects delivered their promises on time, within approved budget and satisfied their users (Table 5.3). Although the HERG payback model overlooked these measures, other works on R&D have addressed them. The measures, together, form a standard platform for evaluation of research projects.

FP and BS groups appear to not give much weight to the measure “*User satisfaction*”, and neither of the AP or BS groups mentioned “*Completion within budget*”. This may be because the BS group may not deal directly with end-users to the extent other groups do. The other two measures in this category appeared widely accepted by all groups.

### 5.3.3 Category two: knowledge production

In this category success measures related to “**Knowledge production**” and dissemination were considered, see Table 5.4. The thematic analysis of 27 statements formed two measures in this category; “*New knowledge*” and “*Scientific publications*”.

Knowledge production	Extracts	Extracts by Nature of science			Extracts by Rank of researchers			Extracts by Administrative experience	
		SS N= 6	BS 7	AS 9	FP 8	MP 8	AP 6	AE 13	LAE 9
New knowledge	5	1	1	3	3	2	0	4	1
Scientific publications	22	6	7	9	8	8	6	13	9
<b>Total</b>	<b>27</b>	<b>7</b>	<b>8</b>	<b>12</b>	<b>11</b>	<b>10</b>	<b>6</b>	<b>17</b>	<b>10</b>

Table 5.4: Distribution of extracts in the category “Knowledge production” based on different interview groups.

#### 5.3.3.1 Measure 5: new knowledge

Knowledge discovery and R&D is all about “invention”. The discovery of new knowledge, or more evidence for existed knowledge, was, in itself, seen as a

measure of success. The scientific community of SQU stressed that the main issue in academic research

*“is the knowledge”. (Interviewee, 09)*

Knowledge discovery in academia, at least, was not valued if not made available to the academic community. However, research by its nature provided mankind with new knowledge which, in itself, was seen a measure of success, even if it was not made publicly available. For example, research taught researchers something that they did not know before, this by itself was seen a measure of success:

*“research is educative”. (Interviewee, 12)*

*“it teaches something”. (Interviewee, 03)*

New knowledge enabled different societies to know what they did not before the project. For example, government, scientific and society communities:

*“did not know what kind of diversity, bio-diversity existed there but this one {project} has told them you have very important bio-diversity in this part of the world”. (Interviewee, 09)*

Uncovering phenomenon was another suggested form of discovery. For instance, a research project was seen successful because it

*“identified the problem which is a disease that is transferred from tree to tree by insects”. (Interviewee, 02)*

Unlike the general knowledge, this measure served to solve some mysterious phenomenon and natural puzzles. Discovery of new research methodology was, also, indicated as discovery of new knowledge. The research project that developed or enhanced the understanding of new research method was successful. For example, a research project

*“developed a new methodology”. (Interviewee, 06)*

The measure “*New knowledge*” was considered a form of success. This finding supports HERG model (Buxton and Hanney, 1994; Hanney et al., 2004). A successful project provided new knowledge and/or tools for better analysis of research problems.

The measure “*New knowledge*” scored 5 (18.5%) out of 27 extracts in this category (Table 5.4). While some interviewees thought of knowledge as a measure of success in itself, no member of the AP group rated this a measure in the success of R&D projects. It is possible that the members of the AP group included this in the measure “*Scientific publications*” (next) and they may not have distinguished between the two. Table 5.4 suggests they might distinguish between them as they progress in their career and develop their intellectual understanding.

### **5.3.3.2 Measure 6: scientific publications**

In academia, generally, knowledge production is usually measured in terms of number and quality of scientifically reviewed publications such as refereed journal articles, books, chapter in a book, conference papers etc. Academic promotion often depends on “*Scientific publication*” therefore academics

*“take it for granted that all what they are required to do is to publish”. (Interviewee, 02)*

This measure was given as a major criterion in the performance measurement of SQU research by all interviewees. If the results of the research project were published in an academic medium it was considered successful because the researcher’s career was advanced and his/her reputation enhanced.

*“I published many papers from these research activities and my career been developed as a result of these activities, I became known in my field mainly because of these projects, so what can I say. I think that is success to me”. (Interviewee, 07)*

*“I have successful research that has some publications”. (Interviewee, 20)*

*“The benefit for research team is we published 5 papers from this project”. (Interviewee, 11)*

*“We wrote a paper about it, published already”. (Interviewee, 08)*

Some interviewed researchers were selective in which journals they published. They emphasised publication in high rank and first class journals, and distinguished between low and high quality publications. A research project published in a highly ranked journal was considered more successful than one that was published in lower quality journals.

*“The most important is to publish in renowned international journal recognized as academic”. (Interviewee, 08)*

*“We published four papers in a number one journal”. (Interviewee, 06)*

*“It resulted in very good publications and we made a major breakthrough ... Indicators of success are standard criteria of publication and we have to publish in the best international Journals, the best papers which are web cited and acknowledged by the International Community”. (Interviewee, 14)*

Scientific publications were extended to include conference papers and speeches at symposiums. They were thought as important as journal articles and indicated success.

*“We presented our result in a conference”. (Interviewee, 08)*

*“Presentations in conferences, symposia and publications; these are things that can be counted”. (Interviewee, 06)*

Successful projects contributed to mankind’s knowledge through “*Scientific publication*”. This finding confirms the HERG model (Buxton and Hanney, 1994; Hanney et al., 2004).

The measure “*Scientific publications*” scored 22 (81.5%) out of the 27 extracts in this category “**Knowledge production**” (Table 5.4). However, every

interviewee identified this measure as important in the evaluation of quality and standard of academic research.

### **5.3.3.3 Summary of category two – theme 2**

Thematic analysis of 27 extracted statements from interviews with academic researchers revealed two measures of success. “**Knowledge production**” was evaluated with the use of the measures; “*New knowledge*” and “*Scientific publications*”. Each one of these measures indicated a certain degree of success. The findings confirm HERG’s work (Buxton and Hanney, 1994; Hannay et al., 2004) and the Higher Education literature (Arnold and Balázs, 1998; Connell, 2004; Langford et al., 2006).

The measure “*New knowledge*” was not indicated by any member of the AP group. This may suggest that academics use this measure as they progress in their career.

### **5.3.4 Category three: educational contributions**

The importance of research to enhance the teaching process was highlighted by some interviewees. 19 extracts identified whether teaching informed teaching as an element in judging the success of a research project. From these extracts, two measures resulted; “*Curriculum development*” and “*Student's career enhancement*”, see Table 5.5. These measures are discussed in the following sub-sections.

Educational contributions	Extracts	Extracts by Nature of science			Extracts by Rank of researchers			Extracts by Administrative experience	
		SS	BS	AS	FP	MP	AP	AE	LAE
		N= 6	7	9	8	8	6	13	9
Curriculum development	9	3	4	2	4	2	3	5	4
Student's career enhancement	10	3	3	4	2	3	5	5	5
<b>Total</b>	<b>19</b>	<b>6</b>	<b>7</b>	<b>6</b>	<b>6</b>	<b>5</b>	<b>8</b>	<b>10</b>	<b>9</b>

Table 5.5: Distribution of extracts in the category “Informing teaching” based on different interview groups.

### 5.3.4.1 Measure 7: curriculum improvement

“Curriculum development” as a measure of success was emphasised by some participants. A research project, for example, helped the team to provide their students with most recent information in the field in general and in the country in particular.

*“Our results we try to incorporate into our undergraduate courses... they {students} get all cutting edge, recent information on what is going on in this facility in their own country”. (Interviewee, 14)*

Another said research provided students with real life material. Students benefited from this project more than they did from textbooks. A more focused approach towards actual problem research provided students with cutting edge information. They took this information to their employers and served the country at large.

*“I have been working on an actual problem attempting to solve a real life problem, it is not easy but it is something. If achieved it is much better than publishing 100 papers in my opinion. Something like why SME enterprises are failing most of the time, and what does it require to increase their rate of success? I teach my students real life problems in the classrooms so research needs to*



*reflect in our daily teaching because I do not believe that theoretical material will make any good in regards to their employment neither to the country". (Interviewee, 22)*

Research techniques were incorporated in taught courses. Not only information and knowledge related to the field were transferred to students but also research technique and the culture of research. These research projects:

*"guide student to do research". (Interviewee, 04)*

Research in general was assumed to feed into the teaching of students. SQU, as an academic organisation by mission, was in a position to use all available resources for its students as first priority. The use of research projects as teaching resource was emphasised as a measure of R&D success. A researcher, for instance, claimed his project was successful because it

*"teach our students". (Interviewee, 14)*

"Curriculum development" indicated R&D contribution to teaching process. "Educational contributions" has been argued in the literature for its importance as a measure of academic research success (Arnold and Balázs, 1998; Connell, 2004; Langford et al., 2006).

The measure "Curriculum development" scored 9 (47.4%) out of the 19 extracts in the category "Educational contributions" (Table 5.5). Interviewees from every group identified this measure and this reflects its importance as a measure of the performance of academic research.

#### **5.3.4.2 Measure 8: student career enhancement**

Another emphasised form of R&D contributions to teaching process was "Student career enhancement". Among SQU researchers it was believed that successful research projects provided opportunities for students and employers. Students who were involved in R&D had better employment offers as compared to the local market conditions. Employers had "research led" up-to-date knowledge transferred through students. For example a research student (who

worked as a research assistant) was employed by an international company because he was involved in this research.

*“A Korean company ... seen my name in this field and approached me. They asked me to test my model at a site of their selection and now they employ my research assistant. They gave him a better offer than PDO, that is one of my project benefits”. (Interviewee, 05)*

Successful research added value to the careers of sponsored students. Students were promoted to higher positions as a direct result of their involvement in these research projects. Employers were either convinced of the added value of their employees' involvement in this research or they were afraid that these employees might leave them to another competitor. Employees had benefited from their involvement in research.

*“The student who worked with me, he was from the Ministry ... he was the Director when he was a student and later he was appointed as Director General for one of the regions”. (Interviewee, 16)*

Training of postgraduate student was seen as a contribution to the teaching process. Involvements of postgraduate students in research enhanced their chances for a better career. It also paved the way for future collaboration. This therefore worked as a success measure at a certain stage and as a success factor at a later one.

*“We've delivered training to one PhD student and one MSc student”. (Interviewee, 02)*

*“I tend to involve MSc and PhD students in my research projects, this is with the intention; (1) to develop Oman human taskforce and (2) to enhance our relations with industry and the public sectors because these students will form links with these organizations”. (Interviewee, 22)*

“Student career enhancement” indicated R&D contribution to the teaching process. Hiring of people in order to gain access to tacit knowledge is argued in

the literature of Higher Education (Arnold and Balázs, 1998; Connell, 2004; Langford et al., 2006).

The measure “*Student career enhancement*” in the category “**Educational contributions**” scored 10 (52.6%) out of the 19 extracts in the category, see Table 5.5. All groups of interviewees identified this measure which reflects its importance to the measurement of academic research performance.

#### **5.3.4.3 Summary of category three – theme 3**

The thematic analysis of 19 extracted statements revealed two “**Educational contributions**” to teaching process; “*Curriculum development*” and/or “*Student’s career enhancement*” (Table 5.5). This category has been a common measurement criterion for the successful performance of academic research however the HERG payback model overlooked it. The Humboldt concept of university research emphasised the conduct of research to inform teaching (Etzkowitz, 1989). The literature of Higher Education stressed the importance of research to inform teaching (Arnold and Balázs, 1998; Connell, 2004; Cooper et al., 2006). However, the use of “*Curriculum development*” and/or “*Student’s career enhancement*” to indicate informing teaching is newly derived here. Interviewees from all groups identified this category which reflects its wide acceptance as a measure of the success of academic R&D.

#### **5.3.5 Category four: capacity building**

The analysis showed that the academics considered building a solid R&D capacity in their department, school and university as a measure of research success.

*“We are building on our strength”. (Interviewee, 06)*

Some participants believed that successful research build on institutional R&D capacity. Five measures were identified from thematic analysis of 32 extracts; “*Contribution to intellectual capacity*”, “*Contribution to infrastructure*” and

“Contribution to institutional reputation” (Table 5.6). The following sub-sections discuss these measures in detail.

Capacity building	Extracts	Extracts by Nature of science			Extracts by Rank of researchers			Extracts by Administrative experience	
		SS	BS	AS	FP	MP	AP	AE	LAE
		N= 6	7	9	8	8	6	13	9
Contribution to intellectual capacity	10	5	1	4	3	4	3	7	3
Contribution to infrastructure	8	2	2	4	4	2	2	6	2
Contribution to institutional reputation	14	4	4	6	6	3	5	9	5
<b>Total</b>	<b>32</b>	<b>11</b>	<b>7</b>	<b>14</b>	<b>13</b>	<b>9</b>	<b>10</b>	<b>22</b>	<b>10</b>

Table 5.6: Distribution of extracts in the category “Capacity building” based on different interview groups.

**5.3.5.1 Measure 9: contribution to intellectual capacity**

Research culture, or critical thinking as some interviewees phrased it, contributed to R&D capacity building. Researchers looked forward to improving the culture of research in SQU. The project that improved research culture was considered to have an element of success.

*“If we can build a {research} culture we will look forward to it”. (Interviewee, 12)*

*“If we can make everyone in SQU to think critically at the end of a project that is an element of success”. (Interviewee, 06)*

Research culture needed to be enhanced in SQU, and in industry as well. The creation of a research culture in local industry would ultimately feed back into SQU research in the future. Academics

*“train the industry with real scientific approach and critical thinking”. (Interviewee, 22)*

Continuity of research contributed to intellectual capacity building. It added bricks one on top of the other in an overall R&D structure. It was used to measure R&D performance by individuals, for example some research projects were successful because they created a foundation for further research in SQU. The message was clear and that if R&D outcome

*“could be used ... for further research”. (Interviewee, 22)*

It indicated an opportunity which in itself was a credit to the research project.

*“It has been successful and out of that also we have been able to work on another topic”. (Interviewee, 17)*

*“So now they have a base that somebody already did some work, so they can take it from that point to the next”. (Interviewee, 08)*

The Nobel prize is the dream of many academics. Maintenance of a high standard of research in order to win such prizes was emphasised. It was believed to enhance personal intellectual capacity and reputation.

*“One of the criteria in determining the top 500 Universities is whether one or more of the academic staff won a prize from an International organization such as Nobel”. (Interviewee, 11)*

*“Contribution to intellectual capacity”* was considered a measure of success of academic research. Research that opened a new research window or highlighted priorities for further research had been successful. Research work that was recognised in the form of academic prizes was successful. The HERG payback model included the development of research skills, analytical thinking and further research as measures of success for NHS R&D (Buxton and Hanney, 1994; Hanney et al., 2004). Higher Education literature has taken the Nobel Prize as the highest international recognition for novel and extraordinary work (Arnold and Balázs, 1998; Connell, 2004) but not as a measure of R&D success at project level.

“*Contribution to intellectual capacity*” recorded 10 (31.2%) out of the 32 extracts in the category “**Capacity building**” (Table 5.6). Interviewees from all groups identified this measure which reflects its importance for performance measurement of academic research.

#### **5.3.5.2 Measure 10: contribution to R&D infrastructures**

“*Contribution to R&D infrastructure*” added value to institutional research capacity. New equipment and other facilities brought to departments by the R&D project increased the research capacity of the department and therefore the research project was seen successful, by many participants.

*“The capacity is increased by this project and also by the purchase of equipment”. (Interviewee, 02)*

Equipment, by itself, added value to R&D capacity especially when there was someone to operate and maintain it. Training of departmental technicians and/or staff needed to be ensured in order to score more successful results.

*“Working with Technicians, we have new systems we have new equipment, they work with the new equipment, they are able to manage it, run it, work it, use it in another capacity ... We have trained, local, technicians; they have equipment now and they are expert on how to run it”. (Interviewee, 18)*

New research collaboration significantly contributed to R&D infrastructures as it compensated for shortfalls in the organisational R&D facilities. It brought in tacit knowledge and other forms of resources such as access to laboratories and other facilities.

*“The {R&D} capacity of the university to do research is being increased because most of this research is done in collaboration with external bodies”. (Interviewee, 02)*

In summary, “*Contributions to R&D infrastructure*” occurred through purchased equipment and collaboration with external organisations as a direct result of the R&D project. HERG’s payback model considered collaboration as a payback of

R&D (Buxton and Hanney, 1994; Hanney et al., 2004) but overlooked the value of newly acquired facilities to “**Capacity building**”.

The measure “*Contribution to R&D infrastructure*” scored 8 (25%) out of the 32 extracts in the category “**Capacity building**” (Table 5.6). Interviewees from all groups identified this measure. This wide acceptance reflects the importance of this measure for the performance measurement of academic research.

### **5.3.5.3 Measure 11: contribution to institutional reputation**

Institutional reputation was seen, among SQU researchers, as a major contributor to institutional R&D capacity and competitive advantage. Dissemination of knowledge in different types of publication mediums and mechanisms added to the institutional reputation and were given an advantage in research performance measurement.

*“The university sure would like to hear something about publications as well as conference attendance and if possible some press release or TV/Radio program as that, you know, enhances its reputation”. (Interviewee, 07)*

*“PI could claim some papers on some journals ... that help his career and CV and perhaps SQU’s reputation”. (Interviewee, 07)*

Companies that were already in the country or expanding in local markets searched for expertise in their fields. Institutional reputation added advantage for research income.

*“A company, an international one, ... before it comes to work in Oman will look in the international records for universities in Oman and which one is existing in the field of expertise they operate in”. (Interviewee, 05)*

Publicly funded research programmes and the resultant publications boosted a team’s reputation. For example, a team received an invitation from highly reputation institution to submit a proposal. This was seen as a measure of success in itself.

*“We are recognised to be working on common diseases in Oman. You see Harvard invited us to submit a proposal which we did, but did not succeed. The fact that we are invited by Harvard is an element of success”. (Interviewee, 06)*

In other R&D projects, similar invitations resulted in collaboration with world class universities and research centres.

*“Establishing collaboration is an element of success, collaboration that was not there before the project”. (Interviewee, 06)*

*“Successful project is that brought plenty of new ideas and very good collaboration with overseas and regional scientists”. (Interviewee, 14)*

While conference publication was a form of “*Scientific publication*”, organising conferences and symposiums contributed to institutional reputation. Conference attendance enhanced institutional presence in the academic community while organising conferences brought other institutions and industries to SQU. This, arguably, had a higher impact on the reputation of SQU.

*“Hereafter completion of the project we had an international conference {in SQU}”. (Interviewee, 09)*

Non-scientific publications were referred to as another contribution to institutional reputation. Publicising SQU works in some media programmes enhanced its reputation in industry and public sectors. For example, one of the interviewees reviewed a paper for his colleague. The paper was intended for news release in a local newspaper. SQU needed more of this in order to promote its success, at least within the country. A lot of good work was being done in SQU but public authorities and business sectors in Oman did not know about it.

*“One of my ... colleagues sent me an article asking me to review. He wants to publish it in the English newspaper; that is exactly what we need to do”. (Interviewee, 02)*



Research that contributed to the institutional reputation held an element of success. Institutional reputation was enhanced through various forms of publications and event organising. HERG's model overlooked this measure, however R&D literature has addressed it. For example Ottenbacher et al., (2006) used a list of 12 measures to define success of New Service Development (NSD) projects. One of these measures was image improvement.

The measure "*Contribution to institutional reputation*" scored 14 (39.3%) out the 32 extracts in the category "**Capacity building**" (Table 5.6). Interviewees from all groups identified this measure which reflects its value as a performance measurement of academic research.

#### **5.3.5.4 Summary of category four – theme 4**

The thematic analysis of 32 extracted statements from interviews with SQU academics concluded that building R&D capacity was a criterion for measuring R&D success. Contributions to "**Capacity building**" took different perspectives; "*Contribution to intellectual capacity*", "*Contribution to R&D infrastructure*" and "*Contribution to institutional reputation*", see Table 5.6. The first two measures contributed to institutional R&D capacity which enabled future research. The latter enhanced the other two measures and contributed to R&D capacity. The value of newly added facilities, as a result of R&D, was newly found by this study. The findings of other measures support HERG's model (Buxton and Hanney, 1994; Hanney et al., 2004), R&D literature (Ottenbacher et al., 2006) and Higher Education literature (Arnold and Balázs, 1998; Connell, 2004). These findings were widely accepted by all interview groups.

#### **5.3.6 Category five: institutional economic benefits**

Public research fund could work as seed funds that enable academics to stand on their own feet and establish industrial research contracts. This possibility was recognised in 20 extracts. The thematic analysis of these extracted statements revealed three types of economic values for academic research;

*“Industrial linkages”, “Research Income”, and “Income from IP and products”* (Table 5.7).

Institutional economic benefits	Extracts	Extracts by Nature of science			Extracts by Rank of researchers			Extracts by Administrative experience	
		SS	BS	AS	FP	MP	AP	AE	LAE
		N= 6	7	9	8	8	6	13	9
Industrial linkages	3	3	0	0	1	2	0	2	1
Research Income	7	2	2	3	3	2	2	4	3
Income from IP and other products	10	4	4	2	3	5	2	6	4
<b>Total</b>	<b>20</b>	<b>9</b>	<b>6</b>	<b>5</b>	<b>7</b>	<b>9</b>	<b>4</b>	<b>12</b>	<b>8</b>

Table 5.7 Distribution of extracts in the category “Institutional economic benefits” based on different interview groups.

### 5.3.6.1 Measure 12: industrial linkages

New linkage with industrial sector was indicated as measure of success of R&D. few participants believed that once relationships were made available, industry facilitated further research projects. For example, the objective of strengthening collaboration with industry was emphasised in one research project.

*“Collaboration with industry and other ministries and public authorities which I’m planning to strengthen in the forthcoming projects that I intend to propose. I have established some links but still need further strengthening”. (Interviewee, 07)*

Another project aimed

*“to enhance our relations with the industry and the public sectors”. (Interviewee, 22)*

The importance of building confidence with private sectors was stressed to gain access to further work in the forms of collaboration, consultancies and contract research. Academics used publicly funded R&D to achieve this objective.

*“We produce reports, we send participating organizations results, because they had participated we send them the results, now they can use it for whatever purpose they want”. (Interviewee, 04)*

The establishment of new “*Industrial linkages*” as a result of publicly funded research leads to more research income in the forms of further collaboration, consultancies and contract research. This measure was overlooked by the HERG work. The Higher Education literatures stressed the importance of this measure in performance evaluation (see Etzkowitz, 1998; Connell, 2004; Hazelkorn, 2005; Pilbeam, 2006 and 2008; HEFCE, 2009).

The measure “*Industrial linkages*” was recognised by 3 (15%) out of 20 extracts in the category “**Institutional economic benefits**” (Table 5.7). All these extracts came from SS interviewees only, one FP and two MPs. The FP and one of the MPs representatives have had AE. This may suggest that academics appreciate this measure as they get exposed to Administration experience.

#### **5.3.6.2 Measure 13: research income**

Some research projects, in SQU, helped their research teams to sign research and/or consultancy contracts with external parties. Consequently, SQU research turnover was increased and these projects were considered successful. In one project, for example, representatives from industry were invited to attend a presentation. Industry in turn invited the team to work on some of their problems.

*“We invited people from the industry and they liked the idea and asked us to carry some studies at their facilities to overcome their electrical grid problems”. (Interviewee, 01)*

Research income from private sectors was seen important to achieve sustained research funding in SQU. More funding meant more research and more potential achievements.

*“As a result of the project money was attracted from the private sector”. (Interviewee, 14)*

*“The question is from that internal research grant how much you can get and attract from external research grant; that’s where a success should be”. (Interviewee, 15)*

*“We got more work with them due to the confidence we gained”. (Interviewee, 22)*

The research project that led to new research income especially from outside organisations was successful. This measure has been considered by the Higher Education literature (see Etzkowitz, 1998; Connell, 2004; Hazelkorn, 2005; Pilbeam, 2006 and 2008; HEFCE, 2009) but was overlooked by the HERG model.

The measure “*Research income*” was recognised by 7 (35%) out of the 20 extracts in the category “**Institutional economic benefits**”, see Table 5.7. All interview groups identified this measure which reflects its significance to measure academic research performance.

### **5.3.6.3 Measure 14: income from IP and products**

The value of income from commercial exploitation of intellectual property and related activities was recognised. This income could help the institution to fund more research and, hopefully, become self-sufficient in term of research funding. The university could contribute to the national economy more directly by being a licensee of patents and copyrighted material. Such activities were of significance for the evaluation of R&D performance.

*“The university needs to start thinking about patents, licensing and creating spin offs. It needs the income from these to feed into research”. (Interviewee, 07)*

*“Universities should be producers in the national economy equation not consumers, and that is only possible from research, for example copyrights and patents”. (Interviewee, 11)*

In one of the projects, the team

*“managed to get at least one patent and it is something that one can see potential commercialization”.*  
(Interviewee, 10)

*“I have successful research that has some publications and probably a patent that could be commercialized”.*  
(Interviewee, 20)

An opportunity to obtain IP rights which could have been exploited for commercial benefits was lost. The team did not file a protection request and published their work. The team recognised this after publication and an element of success was lost.

*“We could have registered that as a copyright, trademark whatever and then commercialized it where we could have benefited”.* (Interviewee, 08)

For some “*Scientific publications*” was goal because of its importance for academic promotion. For other researchers it was seen as a potential for economic benefit. Books, for example, could generate an income from sales. Such benefits were considered as measure of success.

*“Other researchers are able to benefit ... from publication, you know you published part of your dissertation maybe you find a publisher and publish the entire dissertation, the entire PhD thesis”.* (Interviewee, 04)

Research projects that generated income from IP and products were considered successful. This measure has been addressed by the HERG work but at national level. However, the Higher Education literatures has emphasised the use of this measure in performance evaluation at an institutional level (see Etzkowitz, 1998; Connell, 2004; Hazelkorn, 2005; Pilbeam, 2006 and 2008; HEFCE, 2009).

The measure “*Income from IP and products*” was recognised by 10 (50%) out of the 20 extracts in the category “**Institutional economic benefits**”, see Table

5.7. All groups of interviewees identified this measure which reflects its importance as a performance measure of academic research.

#### 5.3.6.4 Summary of category five – theme 5

The thematic analysis of 30 extracted statements from interviews in this study found that academics considered increasing institutional research turnover as a measure of research success. Three types of “**Institutional economic benefits**” have been identified; “*Industrial linkages*”, “*Research Income*”, and “*Income from IP and products*” (Table 5.7).

Links with industry opened new windows for research income, and income from IP and related activities increased the chances of economic benefits. The value of this category was also emphasised by the model developed by HERG group of Brunel University (Buxton and Hanney, 1994; Hanney et al., 2004). The HERG group, however, emphasised the value of economic payback at a national level whereas this study indicates the importance of economic benefits at an institutional level. “**Institutional economic benefits**” have been addressed in the Higher Education literature by, amongst others, Etzkowitz (1998), Connell (2004), Hazelkorn (2005), Pilbeam (2006) and (2008), and HEFCE (2009).

The measure “*Industrial linkages*” was recognised by one FP and two MPs of SS. The FP and one of the MPs representatives had AE. Academics might appreciate this measure as they get exposure to AE. The rest of the measures were widely accepted by all groups.

#### 5.3.7 Category six: policy benefits

Some interviewees incorporated “**Policy benefits**” in the assessment of success of academic research. The argument was that publicly funded research needs to address national issues. The university should not wait for public departments to take the initiative to consult academics. It was the responsibility

of SQU to approach the public as well as private sectors and market its services.

*“Seeking money to do research from the Government of Oman, I think it must serve the Omani need, it wouldn’t be fair to spend that money on something else”. (Interviewee, 02)*

*“The university should be proactive and should go and tell the government that we surveyed the society and the industry and we found these problems”. (Interviewee, 07)*

Two measures were identified in this category as a result of the thematic analysis of 9 extracts; *“Policy modification”* and *“Input to national planning”*, see Table 5.8. These measures are discussed in the following sub-sections.

Policy benefits	Extracts	Extracts by Nature of science			Extracts by Rank of researchers			Extracts by Administrative experience	
		SS	BS	AS	FP	MP	AP	AE	LAE
		N= 6	7	9	8	8	6	13	9
Policy modifications	6	4	2	0	2	2	2	3	3
Input to national plans	3	2	1	0	2	1	0	2	1
<b>Total</b>	<b>9</b>	<b>6</b>	<b>3</b>	<b>0</b>	<b>4</b>	<b>3</b>	<b>2</b>	<b>5</b>	<b>4</b>

Table 5.8: Distribution of extracts in the category “Policy benefits” based on different interview groups.

### 5.3.7.1 Measure 15: policy modifications

Input to public policies was identified as important to measure the performance of academic research. Research ideas served the country’s needs and provided input to the national decision making processes.

*“I choose something of relevance to Oman and which could be used...by policy makers to take some serious decisions based on the results of my research to change certain policies in the country”. (Interviewee, 22)*

For example, a research project aimed at making an impact on farming sector. The aim was to create some awareness and possible changes of practices in relation to sea water intrusion. With the output and impact of the research project, it was considered successful.

*“Most importantly what we are looking for is to have some sort of impact on farmers and some impact on policy makers and decision makers regarding sea water intrusion”. (Interviewee, 17)*

The research project that contributed to national policy changes or modification was successful. The measure *“Policy modification”* was recognised by the HERG model (Buxton and Hanney, 1994; Hanney et al., 2004).

The measure *“Policy modification”* was identified by 6 (66.7%) out of 9 extracts in the category **“Policy benefits”**, see Table 5.8. Only, AS group did not identify this measure.

#### **5.3.7.2 Measure 16: input to national planning**

Some research projects provided public departments with either data or recommendations for further actions. These projects were considered successful. For example, research projects that provided national planners with the data they needed.

*“The government in its strategic planning need data and we will provide them with data”. (Interviewee, 05)*

*“The Ministry ... will look at the recommendations and then go back to their ministries and find the way or mechanism for integrating these recommendations into master plans”. (Interviewee, 09)*

In another example, government planners produced census statistics which indicated some social problem and that needed social researchers to assist in their analysis. Academics contributions to the national plans and analysis indicated success of a R&D project.



*“We have serious problem with the number of divorces and other social indicators they {national planners} do not see. These statistics are very huge data waiting for statisticians to look at and study”. (Interviewee, 07)*

The research that provided input to national plans and other document preparation is considered successful. This measure was overlooked by the HERG model, hence is newly derived here.

The measure *“Input to national planning”* scored 3 (33.3%) out of the 9 extracts in the category **“Policy benefits”**, see Table 5.8. AS and AP groups did not identify this measure.

### **5.3.7.3 Summary category six – theme 6**

The thematic analysis of 9 extracted statements from the interviews with SQU academics found two measures contributing to **“Policy benefits”**. These included; *“Policy modification”* and *“Input to national planning”*, see Table 5.8. Some research findings could be easily incorporated in the form of policy modifications. Others provided information to public planners.

### **5.3.8 Category seven: broader social benefits**

**“Broader social benefits”** from academic R&D were emphasised as measures of success of publicly funded research. Many interviewed researchers highlighted the need to serve socioeconomic requirement. On one hand there was the view of a more relaxed form of working for the society

*“Contributing to society needs and demands, improving conditions, being part of the society at large”. (Interviewee, 19)*

*“We need to do something for the society”. (Interviewee, 21)*

On the other hand there was a more aggressive approach that assumed the utilitarian theory of universities which gave priority to public services.

*“No academic should be promoted if he has not done anything for industry or society”. (Interviewee, 07)*

The university in return should reward researchers that responded positively to the socio-economic issues.

*“SQU also should give preference and incentives to those that work close to real life problems and solve them”. (Interviewee, 07)*

Broader social benefits	Extracts	Extracts by Nature of science			Extracts by Rank of researchers			Extracts by Administrative experience	
		SS	BS	AS	FP	MP	AP	AE	LAE
		N= 6	7	9	8	8	6	13	9
Cultural contributions	12	4	4	4	6	5	1	8	4
Technical contributions	12	3	2	7	4	4	4	7	5
<b>Total</b>	<b>24</b>	<b>7</b>	<b>6</b>	<b>11</b>	<b>10</b>	<b>9</b>	<b>5</b>	<b>15</b>	<b>9</b>

Table 5.9: Distribution of extracts in the category “Broader social benefits” based on different research groups.

In this category, two success measures were identified as a result of the thematic analysis of 24 extracts; “*Cultural contributions*” and “*Technical contributions*” (Table 5.9).

**5.3.8.1 Measure 17: cultural contributions**

Among SQU researchers, success was thought to reflect the extent to which the results of R&D project were used. Use of findings, in itself, was considered a success. For instance, some projects were successful because of indications of use of findings including projects which provided the public community with tools and training on how to use these tools.

*“Those who evaluate SQU research are not only looking at publication. They are certainly looking at other things such as ... use of the results found by the research”. (Interviewee, 07)*

*“To see your work is being utilized in the field definitely that will be the biggest achievement”. (Interviewee, 16)*

SQU conducted a lot of good research but needed to publish this work locally. This kind of publicity would create awareness in the society which should support research in the future. Some projects were considered successful because they either solved a problem in society or at least worked on one which contributed to the society’s awareness of the importance of the matter. For instance, enhancing the awareness of society of a problem and its magnitude and scale was considered a success measure. Society awareness in some occasions resulted in some practice changes as well. The awareness itself was a measure of success.

*“I have attempted to solve a problem that is of priority to the development of Oman”. (Interviewee, 02)*

*“We did not solve the diabetes problem but we created awareness in society about the health problem, we developed a walking pathway for people to start changing their lifestyle and people started to walk and changed certain food habits”. (Interviewee, 06)*

Another project integrated training aspects to enable the use of its model by social authorities.

*“I have a workshop to train teachers in Ministry schools on the use of the test, the ministry requested this training to ensure doing it right”. (Interviewee, 11)*

Other researchers evaluated potential *“Cultural contributions”* before engaging in R&D. A researcher, for example, was invited to participate in a project but he turned the invitation down. He did not see a chance of success in the project i.e. he did not see a potential *“Cultural contributions”* from the project.

*“I did not see or not was not explained clearly enough how they would solve a problem of the Omani development”. (Interviewee, 02)*

The research that provided “*Cultural contributions*” to society was judged successful. The same measure was addressed by the HERG payback model (Buxton and Hanney, 1994; Hanney et al., 2004) and in the Higher Education literature (Arnold and Balázs, 1998; Langford et al., 2006).

The measure “*Cultural contributions*” recorded 12 (50%) out of 24 extracts in the category “**Broader social benefits**”, see Table 5.9. Interviewees from all groups identified this measure which reflects its importance as a measure of the success of academic research.

#### **5.3.8.2 Measure 18: technical contributions**

Contributions to social lifestyle improvements either directly or indirectly was recognised as a measure of success among SQU research staff. Publicly funded research was assumed to tackle public problems. With the use of research findings, public authorities improved services and lifestyles of individuals. Some researchers believed that they were

*“asked to solve problems or at least to investigate real life ones”. (Interviewee, 22)*

Some research programmes addressed national concerns aiming at improving individual’s lifestyle. Successful performances were given to the achievements of these projects. They

*“improve conditions for the farmer or something that will lead to improving the conditions for the farmers”. (Interviewee, 02)*

A research project improved the productivity of public desalination plants which improved the life condition of individuals. The result of the project

*“improved {public desalination plants} productivity”. (Interviewee, 03)*

The recommendation of one of the research projects to policy makers were used to

*“improve the life of the people”. (Interviewee, 22)*

Interviewees thought that it is their responsibility to contribute to the solution of social, economical and technical problems. Contribution to the fulfilment of this responsibility was recognised during R&D idea generation. Academic R&D should

*“be used to solve national problems”. (Interviewee, 20)*

For instance, a research project was successful because it developed a device that assisted in solving a local problem.

*“We designed something that works”. (Interviewee, 03)*

The research that assisted social improvements through solving technical problems was successful. This measure was addressed by the HERG payback model (Buxton and Hanney, 1994; Hanney et al., 2004) and in the literature of Higher Education (Arnold and Balázs, 1998; Langford et al., 2006). Successful products met customer needs, had better quality, solved problem with competitive products, reduced customer's total costs and was an innovative first in the market (Cooper, 1993 and 2001; Goffin and Mitchell, 2005; Henard and Dacin, 2010).

The measure *“Technical contributions”* was indicated by 12 (50%) out of the 24 extracts in the category **“Broader social benefits”** (Table 5.9). All interview groups identified this measure which reflects its importance to the performance measurement of academic research.

### **5.3.8.3 Summary of category seven – theme 7**

The thematic analysis of 24 extracted statements from the interviews with SQU academics found two measures contributing to the category **“Broader social benefits”**; *“Cultural contributions”* and *“Technical contributions”*, see Table 5.9. HERG's model included similar measures but under the category **“Health benefits”** (Buxton and Hanney, 1994; Hanney et al., 2004). The model measures were specific to the public health sector such as reduction in mortality

and morbidity. This study supports the findings in the literature of Higher Education (Arnold and Balázs, 1998, Langford et al., 2006) and provides general framework for “**Broader social benefits**”. The measures in this category were widely accepted by all groups of interviewees.

## **5.4 DISTRIBUTION ANALYSIS**

In this section, the distributions of measures of the interviewees are presented. This includes the distribution of measures on each group of interviewees; nature of science (based on College from which interviewee came), interviewee’s academic post, and experience or lack of it in research administration.

### **5.4.1 Distribution of extracts and measures on interviewees based on their nature of science**

BS researchers recorded 40 (26.1%) extracts and an average of 2.2 measures per researcher. Extracted statements from these interviews ranged from a minimum of 3 to a maximum of 8 extracts with an average of 5.7 extracts per interview. AS researchers recorded 57 (39.2%) with an average of 3.3 measures per researcher. Extracts from these interviews ranged from 4 to 10 extracts with an average of 6.7 extracts per interview. SS recorded 53 (34.6%) and an average of 2.9 measures per researcher and extracted statements ranged from 2 to 14 with an average of 8.8 extracts per interview, see Table 5.10. This finding suggests that AS and SS researchers use more forms of success measures to evaluate academic research projects than their colleagues in BS. This could be because AS and SS researchers deal with end users and respond to policy and social needs more directly than their colleagues in BS.

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<b>Nature of science</b>	<b>Number of interviewees</b>	<b>No. of extracts</b>	<b>% of extracts out of 153</b>	<b>Average of extracts (extracts per</b>	<b>Average extracts per interview</b>	<b>Range of extracts</b>
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				measures)		
BS	7	40	26.1	2.2	5.7	3 - 8
AS	9	60	39.2	3.3	6.7	4 - 10
SS	6	53	34.6	2.9	8.8	2 - 14

Table 5.10: Distribution of extracts based on their College.

#### **5.4.2 Distribution of extracts and measures on interviewees based on academic post**

FP scored 64 (35.3%) statements and an average of 3.0 measures per researcher. Extracts from FP’s interviews ranged from 3 to 13 extracts with an average of 7.7 extracts per interview. MPs made 59 (38.6%) statements and an average of 3.3 measures per researcher. Extracts from the interviews with MP group ranged from 2 to 14 extracts with an average of 6.7 extracts per interview. APs marked 40 (26.1%) extracts and an average of 2.2 measures per researcher. The statements extracted from AP interviews ranged from 5 to 8 extracts with an average of 6.7 extracts per interview (Table 5.11). These finding suggests that relatively inexperienced APs use fewer measures to assess the success of academic research, and that as more experienced is gained in research the more an academic tends to use other, additional measures of success.

Researcher rank	Number of interviewees	No. of extracts	% of extracts out of 153	Average of extracts (extracts per measures)	Average extracts per interview	Range of extracts
FP	7	54	35.3	3.0	7.7	3 - 13
MP	9	59	38.6	3.3	6.7	2 - 14
AP	6	40	26.1	2.2	6.7	5 - 8

Table 5.11: Distribution of extracts based on academic post.

### 5.4.3 Distribution of extracts and measures on interviewees based on their administration Experience

AE researchers contributed 93 (60.8%) statements and an average of 5.2 measures per researcher whilst LAE researchers contributed 60 (39.2%) extracts and an average of 3.3 measures per researcher, see Table 5.12. Extractions from interviews with the AE group ranged from 3 to 13 extracts (average of 7.2 extracts per interview) in comparison to 2 to 10 (average of 6.2 extracts per interview) from the LAE group. This indicates that the more the researchers are exposed to Administration Experiences the more they use combinations of success measures.

Administration experience	Number of interviewees	No. of extracts	% of extracts out of 153	Average of extracts (extracts per measures)	Average extracts per interview	Range of extracts
AE	13	93	60.8	5.2	7.2	3 - 13
LAE	9	60	39.2	3.3	6.7	2 - 10

Table 5.12: Distribution of extracts based on Administration Experience.

### 5.4.4 Conclusion

In this study the major contributions to the findings on measures of success were made by FP and MP of AS and SS who had AE. This finding suggests that AS and SS researchers were open to more forms of success measures than their colleagues in BS, possibly because they deal with end users and applied research. It also suggests that career progression and/or exposure to AE assists academics to combine different measures of research success.

## 5.5 CHAPTER SUMMARY

In this chapter, the results of the success measures were presented. A total of 18 measures were identified by the use of thematic analysis. They were categorised in seven categories; “**Standard measures of project success**”,



“**Knowledge production**”, “**Educational contributions**”, “**Capacity building**”, “**Institutional economic benefits**”, “**Policy benefits**” and “**Broader social benefits**”.

“**Standard measures of project success**” forms a standard platform for evaluation of research projects. “**Knowledge production**” is a basic foundation for other measures. The research that did not contribute to new knowledge or confirm existing knowledge could not satisfy other criteria of performance measurements. Produced knowledge enhanced and/or informed the process of teaching: “**Educational contributions**”. Research projects built on institutional “**R&D capacity**” helped enable the success of future research and opened new research horizons for the institution. Research brought some “**Institutional economic benefits**” through new research and consultancy work for industry and income from commercialisation of IP. Research also had some “**Policy benefits**” such as “*Policy modification*” and “*Input to national planning*”. Finally academic research recorded some “**Broader social benefits**” in the form of problem solving and general use of research findings.

Some of the measures in these themes were identified by the HERG work (see Buxton and Hanney, 1994; Hannay et al., 2004) and in the R&D literature (see Cooper, 1993 and 2001; Goffin and Mitchell, 2005; Henard and Dacin, 2010) and others in Higher Education literature (see Arnold and Balázs, 1998; Geuna 2003; Langford et al., 2006). The value of newly acquired facilities, as a result of R&D, was newly found by this study. The measure “*Input to national planning*” was also newly derived here from empirical evidence.

The technique of distribution analysis showed that AS and SS researchers were open to more forms of success measures than their colleagues in BS. FP and MP with AE used combinations of success measures. This may suggest that career progression and/or exposure to AE assists academics to appreciate additional forms of success for their research.

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## 6 FINDINGS: IMPLEMENTATION EFFECTS

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### 6.1 INTRODUCTION

The aim of this study is to derive, empirically, the effects of R&D implementation on research performance in SQU. This includes the intention to find out what determines successful performance, as perceived by research staff as SQU. The detailed qualitative data analysis, discussed in chapter four, was used to derive twelve themes; seven success measure and five implementation effects. The measures of success are “**Standard measures of project success**”, “**Knowledge production**”, “**Educational contributions**”, “**Capacity building**”, “**Institutional economic benefits**”, “**Policy benefits**” and “**Broader social benefits**”. The implementation effects are “**Strategy related effects**”, “**Task/Project related effects**”, “**Team related effects**”, “**Organisational effects**” and “**Behavioural effects**”. As discussed in chapter five, for reasons of simplification the findings of success measures were presented separately (in chapter five) from those for implementation effects. In this chapter, the effects of implementation are presented.

The structure of this chapter is similar to that used in chapter five. First the emergent themes (categories) of implementation effects are discussed. This includes a list of 30 sub-themes or effects and the distribution of these effects into categories. Distribution analysis also shows what result was obtained from which interview.

### 6.2 PRESENTATION OF THE FINDINGS

The grounded theory approach used in chapter five was used to thematically analyse the data to identify implementation effects. Similar statements or extracts were coded under a “Free Node” as seemed relevant to form an effect (open coding process). As the interviews progressed, the number of newly

emerging effects decreased as many of them had already emerged from previous interviews. The analysis of the first 9 interviews reached “Data saturation” for the identification of implementation effects, see Figure 6.1. The rest of the interviews re-emphasised effects that emerged from analysis of the first 9 interviews. The study, therefore, claims that all possible implementation effects have been found and that the “completeness” of the listings developed as the “family of answers” is robust.

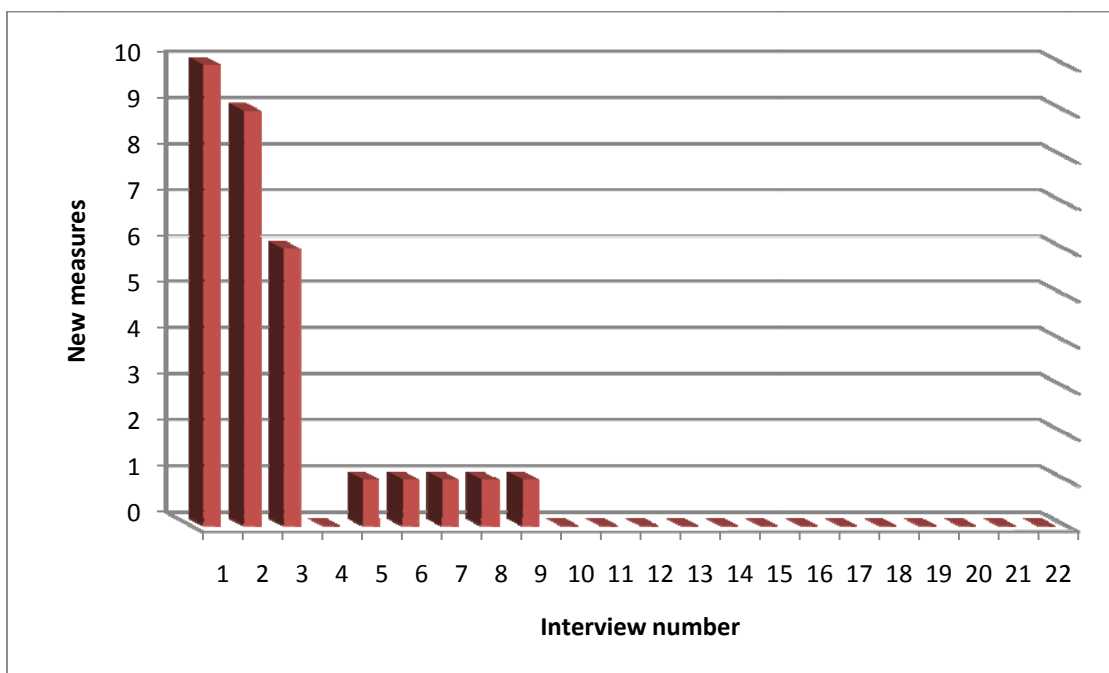


Figure 6.1: Numbers of effects as they emerged from the interviews

Following the open coding process, and sometimes simultaneously, an axial coding process was used, as discussed in chapter five. Relationships between the emerged “Free Nodes” (effects) were examined in a bottom up hierarchy. The emerged effects were grouped together based upon their relationship. A structure (tree) of effects formed as data analysis progressed and five categories of implementation effects resulted (see chapter 4 for further details).

As discussed in chapter three, the effects found from the literature review were categorised into “**Strategy related effects**” (Jawad, 1995; Balachandra and Friar, 1997; Cooper, 2001; Mallon, 2002; Pilbeam 2002; Goffin and Mitchell, 2005; Millson and Wilemon, 2008; Stendahl, 2009), “**Task/project related**

**effects** ” (Jawad, 1995; Cooper, 2001; Goldenberg et al., 2001; Pilbeam, 2002; Mallon, 2002; Goffin and Mitchell, 2005), “**Team related effects** ” (Booz et al., 1982; Brown and Eisenhardt, 1995; Balachandra and Friar, 1997; Ernst, 2002; Pilbeam, 2002; Goffin and Mitchell, 2005; Harmancioglu, 2007; Barczak et al., 2009) and “**Organisational effects**” (Balachandra and Friar, 1997; Cooper, 2001 and 2005; Ernst, 2002; Mallon, 2002; Pilbeam, 2002; Goffin and Mitchell, 2005; Harmancioglu, 2007; Barczak et al., 2009).

In addition to the four categories identified from the literature review, thematic data analysis showed behavioural effects, such as conflict of interests, on the performance of academic research. These effects were grouped into a new category named “**Behavioural effects**”. The thematic analysis in this chapter is divided into these five categories to present the findings.

The distribution analysis technique, which was used in chapter five, was also used here. This shows which effect resulted from which interview. The frequencies of each finding were indicated in terms of the distribution group discussed in chapter five (nature of the science background of the researcher, rank of the researcher and researcher’s research administration experience).

### **6.3 FINDINGS FROM THEMATIC ANALYSIS**

The thematic analysis of the data revealed a list of 30 effects of R&D implementation on performance of academic R&D, see Table 6.1. This section describes these findings in detail and provides quotations from interviews for each identified effect. The description is structured based on the category classification presented in Section 6.2. It also includes some simple indicators of distribution analysis for individual effects.

**Findings: Implementation Effects**

No	Implementation effect	Interview Number																					frq	
		1	2	3	6	12	13	19	20	16	4	5	7	8	11	22	9	10	14	15	17	18		21
<b>Strategy related effects</b>																								
1	National strategic alliance				√					√	√	√			√				√					6
2	Research priorities	√	√		√	√			√		√										√			7
3	Understanding of business objectives and research mission	√	√						√	√	√	√			√									8
4	User-Institution relationship		√	√	√			√	√	√	√	√					√							11
<b>Task/Project related effects</b>																								
5	Clear objectives		√			√					√	√					√					√		6
6	Project appropriateness and feasibility	√	√	√	√	√	√			√	√	√	√		√		√		√	√		√	√	16
7	Multi-disciplinary research		√					√	√			√			√	√	√	√					√	9
8	Project size			√	√	√				√			√				√							6
9	Project planning			√					√										√					3
10	User involvement and acceptance			√	√				√		√			√	√	√		√	√		√			10
<b>Team related effects</b>																								
11	Team composition							√	√			√	√	√			√	√	√					8
12	Researcher's attitude			√		√				√	√	√	√				√			√			√	9

**Effects of R&D Implementation on the Performance of Publicly Funded Research in SQU**

No	Implementation effect	Interview Number																					freq	
		1	2	3	6	12	13	19	20	16	4	5	7	8	11	22	9	10	14	15	17	18		21
13	Researchers' profiles					√				√							√		√			√		5
14	Skills of the project leader	√		√	√	√	√	√	√			√	√	√	√	√	√	√	√					15
15	Other commitments of research team	√	√	√					√		√	√		√				√				√		9
16	Team communication							√	√				√		√		√		√					6
17	Informed team				√		√					√	√	√	√	√	√	√					√	9
<b>Organisational effects</b>																								
18	Organisational culture		√	√							√		√				√		√				√	7
19	Management commitment and support	√	√	√	√	√	√	√			√	√	√	√	√	√		√				√		15
20	Administrative support	√	√	√		√	√	√				√	√	√			√		√	√	√	√	√	15
21	Clear and flexible rules		√	√				√				√		√			√		√					7
22	Evaluation process	√	√			√			√					√			√				√		√	8
23	Monitoring	√	√	√	√	√					√	√	√	√	√	√	√	√	√	√	√			16
24	Availability of resources		√	√	√	√	√	√	√	√				√	√		√	√		√	√	√	√	16
25	Availability of infrastructures		√		√	√		√	√	√	√						√			√		√	√	11
26	Availability valid data			√					√			√	√		√		√		√		√			8
<b>Behavioural effects</b>																								
27	Motivation			√			√	√				√	√		√		√		√		√	√		10

**Findings: Implementation Effects**

No	Implementation effect	Interview Number																					freq		
		1	2	3	6	12	13	19	20	16	4	5	7	8	11	22	9	10	14	15	17	18		21	
28	Organisational leadership	√	√	√	√	√	√	√			√	√	√		√	√		√				√	√		15
29	Conflict			√	√		√		√			√			√									√	7
30	Politics			√	√	√						√	√			√						√	√		8
Total		10	18	19	14	15	12	16	9	10	8	17	18	11	13	15	21	8	13	8	9	11	11		

Table 6.1: List of the 30 implementation effects found empirically. Columns in light colours show interviewees from social science disciplines while dark ones represent interviewees from basic science disciplines. Clear columns show applied science disciplines.



### 6.3.1 Category one: strategy related effects

The analysis showed some effects related to the formation and implementation of research strategy. The environment in which the institution operated was one of these effects. Operation environment was influenced by the government and other supporting institutions. Public funding for academic research was regulated by national policies. In principle SQU determines certain categories into which its R&D capacity falls. A research project falling into one of these categories does not necessarily ensure successful implementation if other institutions, organisations and parties such as end-users and other environmental factors are not supportive (Carter, 1982; Jawad, 1995; Balachandra and Friar, 1997; Mallon, 2002; Pilbeam 2002; Stendahl, 2009). SQU needed to have a clear strategic research framework to enable researchers to work in parallel with institutional and/or external objectives.

*“You need clear policies and strategies and you need a common understanding of what is required from researchers to do... this could be regarded as a framework”. (Interviewee, 19)*

Strategy related effects	Extracts	Extracts by Nature of science			Extracts by Rank of researchers			Extracts by Administrative experience	
		SS	BS	AS	FP	MP	AP	AE	LAE
		N= 6	7	9	8	8	6	13	9
National policies	6	3	1	2	2	3	1	3	3
Institutional research priorities	7	1	1	5	2	2	3	3	4
Understanding of Institutional business objectives and research mission	8	3	0	5	2	3	3	4	4
User-institution relationship	11	3	1	7	6	3	2	7	4
<b>Total</b>	<b>32</b>	<b>10</b>	<b>3</b>	<b>19</b>	<b>12</b>	<b>11</b>	<b>9</b>	<b>17</b>	<b>15</b>

Table 6.2: Contribution of different research groups to the identification of the category “Strategy related effects”.

The category “**Strategy related effects**” included four effects; “*National policies*”, “*Institutional research priorities*”, “*Understanding of Institutional business objectives and research mission*” and “*Institution-users relationship*” (Table 6.2). These effects were the result of the thematic analysis of 32 extracts.

### **6.3.1.1 Effect 1: national policies**

“*National policies*” were identified as an influential aspect in the success of SQU research: Government funded research and in return the expected payback in light of the new social contract of science. For instance, SQU research was predominantly in agriculture: and the direction of the “*National policy*” in this field was reflected in the focus of the research programme. This placed it on the road to success ahead of its competitors. Consequently, it succeeded in attracting most of the public funds.

*“we know that our success in research is because we are predominant in agricultural research” (Interviewee, 02)*

Another research project was aligned to national desires and objectives. This alignment not only helped it to create a high profile and focus but also assisted it to be successful during the performance evaluation exercise.

*“The government in its strategic planning needed data ... we will provide them with data”. (Interviewee, 05)*

Emphasis was given to strategic importance as a factor for selection of research projects. Projects with strategic importance were seen as having a higher chance of success. Only those projects that had a high potential for success, in terms of their strategic impact, were selected and funded. This process put R&D in line with the concerns of shareholders (Government). SQU used these policies to define niches and research themes.

*“If you ask me why we are submitting a proposal for diabetes, the answer is because we think that it is one of the largest problems in Oman, one out of seven Omanis*

*are diabetic. Could you give me a more strategic issue than tackling the health of one out seven of the population". (Interviewee, 06)*

Governments expected SQU to conduct studies and make suggestions for policy modification and socioeconomic improvements, as discussed in chapter two. SQU research was expected to contribute to the efforts of the government to develop the country. Working in line with these expectations eased the success of research when evaluated at later stages.

The Government was assumed to appreciate provocative approaches when presenting findings and/or proposal for future work. The research strategy with a window for such initiatives could create radical changes in policy levels and future research orientation. With such an approach SQU would be in a better position to provide services better oriented to public organisations and institutions. Research output would be successful in the view of public bodies and this would help ensure a continuous flow of research funds. This understanding was found among those who interacted with governmental bodies in research and other societal committees.

*"the government would like to hear that the university studies this issue and here are the suggestions, study this issue and suggest further study which needs this much funding. Developed certain criteria that most likely will lead small to medium business enterprises will be successful". (Interviewee, 07)*

Successful researchers claimed that:

*"We surveyed the society we found these problems and the industry we found these problems we need your supports to deal with them, I think the government will like to hear that". (Interviewee, 07)*

Project alignment to "National policies" positively affected the performance of R&D in SQU. Higher Education literature has highlighted the effects of policy changes on university research (Etzkowitz, 2000; Nowotny, 2001; Geuna and Martin, 2003). The literature of R&D and related fields has also reported the

effects of “*National policies*” (or public interests) on R&D performance. Successful R&D appears aligned to political interests (Carter, 1982; Pilbeam, 2002). Projects that responded well to the expectations of funding agencies stood a better chance of successful. Institutional research strategies and priorities by Higher Education institutions are known to be responses to the expectations of funding agencies (Bushaway, 2003; Connell, 2004; Hazelkorn, 2005; Reichert, 2006; Pilbeam, 2008; HEFCE, 2009).

The effect “*National policies*” was indicated in 6 (18.8%) out of the 32 extracts in the category “**Strategy related effects**” (Table 6.2). Interviewees from all groups identified this effect which reflects its importance in delivering successful academic research.

### **6.3.1.2 Effect 2: institutional research priorities**

“*National policies*” helped SQU to determine on which areas to focus research. Further, the university’s resources and vision for its future dictated the selection of certain areas out of those falling within the general area of “*National policies*”. The lack of “*Institutional research priorities*” for Internal Grants<sup>7</sup> (IG) projects was a major constraint to the delivery of successful projects in the SQU IGs. Consequently SQU funded research in, almost, all fields and did not optimise resources. As a result many funded IGs were not in line with the “*National policies*” which endangered their success.

*“We need to see the government directions. What do they need? What are the problems for Oman now? Is it water resources, oil and gas, economic diversification? In short a reflection of the national plans, then how can SQU participate in this plan and activities, Of course SQU would not be able to do everything so it needs to specify what it can do within that national plan within skills, budgets etc..”*  
(Interviewee, 05)

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<sup>7</sup> For more details about IG and SR classification see section 2.5

*“Once SQU decides on its priorities then they say now we have to find resources that help in achieving our goals and fulfilling our priorities and requirements, finding human resources. bringing physical resources and building research capacity in the decided field. It depends on the university strategy and short term or long terms goals”. (Interviewee, 20)*

Unlike the IGs, the availability of *“Institutional research priorities”* had a positive effect for Strategic Research (SR) projects<sup>8</sup>. Strategic research areas are imposed on SQU by government departments and social institutions. Only proposals in line with the *“Institutional research priorities”* were considered for funding. Also it shaped the focus of the research team on what was needed from them during the performance measurement process.

*“The project has right objective; it is within the University {research} priorities” (Interviewee, 17)*

*“Research objectives should be evaluated for prior approval to see whether they fall within SQU research strategy and priorities or not”. (Interviewee, 20)*

*“Institutional research priorities”* reflect market demands or *“National policies”* and the priorities of Higher Education systems. Research projects that were guided by institutional *“Institutional research priorities”* were more successful than those projects that lacked this guidance (Bushaway, 2003; Connell, 2004; Hazelkorn, 2005; Reichert, 2006; HEFCE, 2009). In the R&D literature similar conclusions have been reached. Market-oriented research was more successful compared to less market-oriented research (Cooper, 1981; Balachandra and Friar, 1997; Ottenbacher et al., 2006; Herzberg, 2006; Jimenez-Jimez, et al., 2008; Buganza et al., 2010; Henard and Dacin, 2010).

The effect *“Institutional research priorities”* was mentioned in 7 (21.9%) out of the 32 extracts in the category **“Strategy related effects”**, see Table 6.2. This

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<sup>8</sup> Refer to section 2.5 to see how SR projects are evaluated.

effect was common across interview groups, which reflects its weight in the academics' perception of what contributed to successful R&D.

### **6.3.1.3 Effect 3: understanding of institutional business objectives and research mission**

The importance of clear organisational objectives for successful research was stressed. Common understanding of SQU's business mission helped create a shared vision in the organisation. Researchers used this vision to guide their work to success. Some researchers argued, however, that they were not aware of the university research mission, strategy and objectives.

*"You need a common understanding of what is required from researchers and in what way this could be regarded as a framework". (Interviewee, 19)*

*"If you ask me what is the research strategy today in SQU the answer is I do not know simply because I was not told, neither by the HoD nor the Dean or his assistants told us". (Interviewee, 07)*

For example in one project, researchers assumed something and management aimed at something else. A team member was lucky to ask what they were expected to do, as they were assumed to understand the institutional research objectives.

*"We academics take it for granted that we are supposed to publish but that is not always true. In the HM {SR} project I was not the PI but I attended the meeting with the admin. We asked them what is it you expect from us three years down the road when we get the project completed. Their answer did not involve publication. They told us that they wanted us to get involved with industry, solve their problems if we can, and establish some relationships and hopefully get some research contracts. So we know what to focus on and we have done what we were asked to and we promised to. I am not sure that all the researchers at SQU understand clearly what are the main business objectives of the institution. We were recruited and taken*

*for granted that we do understand but that is far away from reality". (Interviewee, 22)*

In the same vein, researchers emphasised that at the start of projects, most of them did not have a clear idea of how their research project will be evaluated. If they were aware of SQU research evaluation requirements, they would have been more focused to satisfy the requirements and deliver successful outcomes.

*"People are not told what is expected from them, if they know what are the parameters that their research will be measured against they will be prepared to give an answer". (Interviewee, 02)*

*"To find out what is it required from you to deliver at the end of the project". (Interviewee, 22)*

Researchers who understood institutional business objectives and research mission delivered successful performance. This finding supports R&D literature. Successful R&D teams understood business organisational objectives (see Souder, 1987; Cooper, 2001 and 2005; Jawad, 1995; Krishnan and Ulrich, 2001; Mallon, 2002; Pilbeam, 2002; Goffin and Mitchell, 2005; Ottenbacher et al., 2006; Johnson and Luo, 2008; Millson and Wilemon, 2008; Stendahl, 2009; Buganza et al., 2010; Henard and Dacin, 2010).

The effect *"Understanding of institutional business objectives and research mission"* was indicated in 8 (25%) out of the 32 extracts in the category **"Strategy related effects"** (Table 6.5). No BS researchers considered *"Understanding of institutional business objectives and research mission"* as necessary for successful research. This could be because of the nature of fundamental work they are involved in.

#### **6.3.1.4 Effects 4: institution-users relationship**

Support for researchers is available from end users and this is facilitated by the nature of the relationship between the university and the end-users. The best

such relationship was the one that allowed close working in an integrated approach. Some successes were referenced to connections with end-users.

*“You’re asking me why perhaps we were successful its part of this connectivity”. (Interviewee, 13)*

Research strategy was influenced by the nature of the relationship of the institution with other players. Positive relationships introduced mechanisms into the research strategy that enabled success. Staff, for example, were cross-posted in different forms. End-users sent postgraduate students to the university and the latter sent technicians and/or academics to work for the former. This enhanced the exchange of tacit knowledge and allowed for strategy adaption, reviews and modifications. It also provided a means of access to data and resources without which research success was severely jeopardised. For example, a problem with obtaining data from an authority resulted in three months delay in the schedule of one project.

*“Seconding staff to and from authorities, they come to work as RAs or MSc or PhD students paid by their authorities, just as we do we second them technicians to work in ministries paid by us that way we can work very closely and then we can create an impact”. (Interviewee, 03)*

*“Internal collaboration is also essential by that I mean with Oman; basically you will not get good data without good collaboration”. (Interviewee, 07)*

*“During the research of course we have lot of meetings, information sharing with the Ministry people and many people different people”. (Interviewee, 16)*

*“They {end-users} are interested in what we are doing. Not only that, they are interested and they are helping us in terms of accessing the data, in terms of getting information from farmers, they have been very helpful”. (Interviewee, 17)*

*“Instead of helping me in 5 minutes you {end-user} cost me 3 months to find the information”. (Interviewee, 09)*



Some academics in SQU were found to have communication problems not only with the wider society but also among themselves. For example, one project failed because of conflict between SQU and the end-user.

*“Academics have communication problem among themselves and with others, especially end users”.*  
(Interviewee, 19)

*“I find there is a conflict between the ministry and SQU”.*  
(Interviewee, 05)

Positive relationship between the university/School and the end-users enabled the successful performance of research. In contrast, negative relationship between the two caused failures in the system. The literature of R&D emphasised similar findings (see Maidique and Zirger, 1984; Cooper, 1990, 2001 and 2005; Balachandra and Friar, 1997; Krishnan and Ulrich, 2001; Ernst, 2002; Goffin and Mitchell, 2005; Ottenbacher et al., 2006; Johnson and Luo, 2008; Johnson et al., 2009; Buganza et al., 2010; Henard and Dacin, 2010).

The effect *“Institution-users relationship”* was indicated in 11 (34.4%) out of the 32 extracts in the category **“Strategy related effects”** (Table 6.2). All interview groups identified this effect which reflects its importance to the successful performance of academic research.

#### **6.3.1.5 Summary of category one - theme 8**

The analysis of 32 extracted statements from the interviews with academic researchers revealed four **“Strategy related effects”**; *“National policies”*, *“Institutional research priorities”*, *“Understanding of institutional business objectives and research mission”* and *“Institution-users relationship”* (Table 6.2).

National strategies and policies assisted universities to draft research niches and research themes in line with their strengths and weakness. Clear *“Understanding of institutional business objectives and research mission”* directed researchers to short term and long term objectives. Working closely with end-users and public bodies to satisfy their expectation put research

projects on the doors of success. The literatures of R&D and related fields included similar effects under the category “**Strategy**” (see Souder, 1987; Craig and Hart 1992; Jawad, 1995; Balachandra and Friar, 1997; Cooper, 2001 and 2005; Krishnan and Ulrich, 2001; Mallon, 2002; Pilbeam, 2002; Goffin and Mitchell, 2005; Ottenbacher et al., 2006; Johnson and Luo, 2008; Millson and Wilemon, 2008; Stendahl, 2009; Buganza et al., 2010; Henard and Dacin, 2010) The effects in this category were common among all interview groups. They are, therefore, of significance to R&D success.

### **6.3.2 Category two: task/project related effects**

The analysis of 50 extracts showed a group of six effects of implementation on R&D performance in SQU. These effects were related to the idea itself, what it intended to achieve and the end result of the project. They included “*Clear objectives*”, “*Project appropriateness and feasibility*”, “*Multi-disciplinary research*”, “*Project size*”, “*Project planning*” and “*User involvement and acceptance*” (Table 6.3). They were grouped under the category “**Task/Project related effects**”.

Task/Project related effects	Extracts	Extracts by Nature of science			Extracts by Rank of researchers			Extracts by Administrative experience	
		SS	BS	AS	FP	MP	AP	AE	LAE
		N= 6	7	9	8	8	6	13	9
Clear objectives	6	2	2	2	3	2	1	4	2
Project appropriateness & feasibility	16	4	5	7	7	5	4	10	6
Multi-disciplinary research	9	3	3	3	5	2	2	9	0
Project size	6	1	1	4	3	3	0	4	2
Project planning	3	0	1	2	2	0	1	3	0
User involvement and acceptance	10	3	3	4	4	3	3	7	3
<b>Total</b>	<b>50</b>	<b>13</b>	<b>15</b>	<b>22</b>	<b>24</b>	<b>15</b>	<b>11</b>	<b>37</b>	<b>13</b>

Table 6.3: Contribution of different research groups to the category “Task/Project related effects”.

### 6.3.2.1 Effect 5: clear objectives

In the opinions of the interviewees successful research depended on several effects, the first one was how clear the team was on what they intended to do and how they were going to do it. Successful teams clearly identified

*“the idea of research, setting the objectives and the milestones”. (Interviewee, 19)*

*“having a road map of what you want to achieve and how you will achieve them- that is exactly what you going to manage later on”. (Interviewee, 19)*

*“You need to set an objective, tasks to achieve that objective and definitely a plan to follow to carry out those tasks”. (Interviewee, 01)*

*“Principal Investigator should state clearly what were the objectives, the objectives for everyone in the same format”. (Interviewee, 17)*

In contrast, less successful researchers did not have clear vision of what they were undertaking. For example, where the scope of a project was underestimated the project tended to be unsuccessful

*“we really underestimated what it required. And we underestimated the goal”. (Interviewee, 12)*

Unclear objectives endangered project performance because research teams did not understand what the proposed method needed in terms of resources. They found later that the project needed more resources than had been budgeted for. The team had to amend some objectives at later stage in order to avoid complete failure.

*“We did not look in depth on the implications of the method we were proposing specifically the manpower so we had to twist one of the objectives and we still produced good results but it was a danger that could have failed our project”. (Interviewee, 02)*

“Clear objectives” enhanced the chances of research success. The researchers and the evaluators were able to see what successful projects intended to achieve and how. This was also emphasised in the R&D literature (Souder, 1987; Cooper, 1990, 2001 and 2005; Balachandra and Friar, 1997; Krishnan and Ulrich, 2001; Goffin and Mitchell, 2005; Ottenbacher et al., 2006; Johnson and Luo, 2008; Buganza et al., 2010; Henard and Dacin, 2010). Clearly defined research method was one of the characteristics of successful projects (Pilbeam, 2002).

The effect “Clear objectives” was indicated in 6 (12%) out of the 50 extracts in the category “**Task/Project related effects**” (Table 6.3). All groups of interviewees identified this effect which reflects its important influence on the performance of academic research.

### 6.3.2.2 Effects 6: project appropriateness and feasibility

*“Project appropriateness and feasibility”* are combined as one effect because most of the extracts combined them. *“National policies”* and *“Institutional research priorities”* (effects 1 and 2) defined research appropriateness. Only appropriate projects were considered for funding, to gain funding support from SQU research proposals had to justify their relevance to Oman. In addition all proposals were subject to feasibility questioning.

*“Research projects at the proposal stage need to justify their relevance to the society before award”. (Interviewee, 21)*

*“We should ask is it possible to do it”. (Interviewee, 09)*

Appropriate and feasible proposals stood better chances of success. If proposals were appropriate but not feasible, administration would advise the research team on how this could be enhanced in order to increase chances of success. Feasibility of proposals could be enhanced by collaboration or involvement of experts.

*“There are two criteria; one is attractiveness and second is feasibility. Let us say that for water proposal there is attraction i.e. SQU is attracted to this proposal, then come the feasibility part - is it feasible for SQU to do it? If not feasible you can increase its feasibility by hiring experts to do that, but if it is not attractive at all we should not be bothered with it at all”. (Interviewee, 03)*

In relation to project feasibility, a cause of failure in R&D was unrealistic objectives. Researchers who proposed unrealistic objectives underestimated what it required to deliver them. Achievement of objectives could be unrealistic due to their nature or because of the approach proposed, time and/or resources constraints. Academic researchers were generally driven by their enthusiasm and tended to forget the limitations of their environments. The only time they realised these limitations was when they faced them.

*“Another cause for failure is that many researchers are not realistic in what they propose. They do not appreciate the limitations that we are surrounded by, the only time they talk about them is when they face them and find themselves in troubles”. (Interviewee, 07)*

At this late stage many researchers got fed up before the completion of the project and the project was cancelled as a failure.

*“I know people who get fed up halfway”. (Interviewee, 12)*

The need to question the cost effectiveness of proposals was indicated too. Projects that were not cost effective failed most of the time. Even if these projects performed well and delivered their promises, they were still considered failures because of the cost involved.

*“Is the cost worth the result? If it does, then it’s something ...but if it doesn’t, I think that’s extremely important... sometimes the magnitude {of the scope} is big but is not cost effective. You require a lot of money to do it”. (Interviewee, 12)*

Project appropriateness addresses “National policies” and institutional “Research priorities” and project feasibility reflects the requirements to tackle a proposed idea. As discussed in Section 6.3.1, these two considerations enhanced the chances of research success. Successful projects were appropriate to the institutional environment (country and market conditions) and had feasible objectives. This finding supports those in the R&D literature. Successful R&D was appropriate to the market it was intended for (see Cooper, 1981; Balachandra and Friar, 1997; Ottenbacher et al., 2006; Herzberg, 2006; Jimenez-Jimez, et al., 2008; Buganza et al., 2010; Henard and Dacin, 2010) and the achievement of their objectives was feasible (see Balachandra and Friar, 1997; Krishnan and Ulrich, 2001; Cooper, 2005; Goffin and Mitchell, 2005; Ottenbacher et al., 2006; Johnson and Luo, 2008; Henard and Dacin, 2010; Buganza et al., 2010). R&D that delivered its promises could be considered a failure if the deliverables were at too high a cost (see Rubenstein et al., 1976; Cooper, 1981 and 2001; Pinto and Slevin, 1987; Balachandra and Friar, 1997).

The effects of “*Project appropriateness and feasibility*” were indicated in 16 (32%) out of the 50 extracts in the category “**Task/Project related effects**” (Table 6.3). This effect was common among all groups of participants. This reflects the significance of this implementation effect on success of academic research.

### **6.3.2.3 Effect 7: multi-disciplinary research**

The nature of the project and tasks undertaken will inevitably influence research performance. For example, some projects succeed because of their multi-disciplinary nature. One discipline alone does not usually solve the real life problem faced by people in Oman, therefore more than one discipline should join together and work on the specific problem. The diversity of disciplines enriches these projects and ultimately contributes to their success.

*“It is successful, first of all, because it is multi-discipline project”. (Interviewee, 10)*

*“The diversity of the disciplines, one discipline does not solve a problem. We need to give priority to multi-discipline projects”. (Interviewee, 11)*

*“... Researchers are working individually, there are no inter-disciplines and we all know that single discipline cannot solve a problem. SQU should put an end to that, no one should be allowed to work alone”. (Interviewee, 07)*

*“The team I had, three people with different backgrounds and few MSc students”. (Interviewee, 22)*

*“A factor is multi-disciplinary research project”. (Interviewee, 19)*

*“It is a multiple disciplinary, trans-disciplinary project involving more than 20 experts, equal number of technician and a similar number of people from the Government/Ministry”.(Interviewee, 09)*

*“The team coming from different backgrounds”. (Interviewee 11)*

The multi-disciplinary nature of R&D brought to the project different backgrounds and experiences which increased the chances of research success. Successful academic research projects were multi-disciplinary (Pilbeam, 2002). R&D literature also stresses the positive influence of multi-functional project performance which interlinks the multi-disciplinary strands of the research (Souder, 1987; Balachandra and Friar, 1997; Cooper, 2001 and 2005; Krishnan and Ulrich, 2001; Goffin and Mitchell, 2005; Ottenbacher et al., 2006; Johnson and Luo, 2008; Buganza et al., 2010; Henard and Dacin, 2010).

The effect *“Multi-disciplinary research”* was indicated in 9 (18%) out of the 50 extracts in the category **“Task/Project related effects”** (Table 6.3). Senior and junior researchers from different natures of research identified this effect. No researcher without experience of research administration mentioned this effect, which may suggest that AE enabled academics to see the contribution of multi-disciplinary nature of their project to its success.

#### **6.3.2.4 Effect 8: project size**

The *“Project size”* was influential on performance of some SQU’s research projects. One project, for instance, was successful solely due to the small size of the project. Small projects required fewer resources, less effort and time and were easier to manage.

*“My internal projects have been successful. Mostly because of the magnitude of the project was small”.*  
(Interviewee, 16)

*“Small projects were very successful because it was a simple question although the technicalities of doing it were just a little bit too much”.* (Interviewee, 12)

The same argument was also emphasised by those who had experiences of failed research projects in SQU. For instance, the failure of strategic research (SR) was attributed to the large size of the project. Bigger projects required more resources to get things done, unfortunately not all requirements were always available and the performance could be compromised.



*“The size of the project, the amount of work is tremendous. So, we need I mean manpower. Of course in the beginning I was thinking that I could hire good students or research assistants. But, later I found out that it is not so easy to get good people”. (Interviewee, 16)*

*“The size of the project itself, I mean what I want to say is that the infrastructure, the infrastructure at SQU doesn’t allow for large size project as yet. If we want to do a large size or bigger scale projects on a bigger scale, we need to have an infrastructure”.(Interviewee, 16)*

Pilot projects were useful in informing the likely effects of “Project size”. In the opinion of some participants, successful research projects were piloted prior to the full scale launch. Piloted projects had lower risk and were of more manageable scope. For example, piloted projects helped their teams to overcome the problem of resources. Management can spend a few thousand to pilot a project if they had doubts about a big project. Only those pilots with promising results would be retained and therefore stand a higher chance of success.

*“Funding is not problem for small projects but it is for big projects because they need big funding”. (Interviewee, 06)*

One team did not take risks. They decided to go for a pilot study first, and when it succeeded the project was fully launched.

*“This is a very hot topic right now, in the research work actually we get a small pilot project. We presented our result in a conference, we wrote a paper about it... we are developing/ extending”. (Interviewee, 08)*

The smaller the R&D project the less the risks involved and the higher the probability of delivery of promises. Bigger projects required more resources and infrastructures that were difficult to find, especially when not seen at the earliest stages of project. This finding confirms those reported in the R&D literature (see Jawad, 1995; Ernst, 2002; Mallon, 2002; Ottenbacher et al., 2006).

The effect “*Project size*” was indicated in 6 (12%) out of the 50 extracts in the category “**Task/Project related effects**” (Table 6.3). No member of the AP group mentioned this effect which may suggest that APs work on smaller projects and only experience the effects of “*Project size*” as they progress in their careers.

#### **6.3.2.5 Effect 9: project planning**

*“I started planning 5 years ago... it is not that I dreamed at night and started next morning”. (Interviewee, 06)*

The importance of planning was an effect appreciated by some participants, who saw need for proper planning to implement a R&D project. Despite the uncertainty imposed by the nature of research activities, a sound plan of what was intended to take place needed to be available upfront. This plan provided a road map for the team and enabled them to deliver their promises.

*“Some projects fail because they are not constructed well”. (Interviewee, 09)*

*“You need to set an objective, tasks to achieve that objective and definitely a plan to follow to carry out those tasks”. (Interviewee, 01)*

*“Principal investigators should state clearly what were the objectives, in the same format the objectives for everyone”. (Interviewee, 17)*

The exercise of planning the project enabled research teams to foresee resource and time requirements. In addition it allowed administrative formalities to be undertaken properly. Nevertheless, projects still failed because the

*“research plan is poor”. (Interviewee, 03)*

*“Many of my colleagues did not estimate how much the research would cost them and finally found themselves short of funds half way though”. (Interviewee, 07)*

Another perspective of planning incorporated a provision for later implementation of the findings. The aim was to transfer knowledge into action as application of the findings was assumed in the criteria for measurement of success.

*“Remember if we think of impact upfront then we can get it in the picture at earlier stages. Every proposal should have its proposed way of transferring the foreseen knowledge to implementation and if not it should not be approved.” (Interviewee, 03)*

*“Preparation for application for physical implementation of the findings, actually this should be clearly defined in the proposal”. (Interviewee, 19)*

Effective *“Project planning”* enhanced the chances of success. Plans enabled research teams to carry through the activities required. Researchers were conscious about achieving their objectives as determined by the plans. They worked to ensure resources and other requirements were in place to achieve objectives on time. The R&D literature indicates that success needs proper and effective plans (see Rubenstein et al., 1976; Maidique and Zirger, 1984; Souder, 1987; Balachandra and Friar, 1997; Cooper, 2001; Goffin and Mitchell, 2005).

The effect *“Project planning”* was mentioned by only 3 out of 22 interviewees, and was 6% of the 50 extracts in the category **“Task/Project related effects”** (Table 6.3). No academic in the MP, SS and LAE groups identified this effect. AE appears to have enabled academics to see the benefits of proper *“Project planning”*. Administration posts enable academics to see other researchers' experiences.

#### **6.3.2.6 Effects 10: users involvement and acceptance**

The source of the idea for the research topic was significant for the success of the project. The higher user-involvement during the processes of idea generation and execution the higher the chances of success the project had.

Some projects succeeded because of the input of end users. In one case the team changed their practice based on the user's advice which led them to succeed. In another project the end users reviewed the project proposal and progress reports. Their comments were very helpful to the project success.

*"Involvement of others comes also at the first place... a lot of researchers ignore experiences of individual users as if they know nothing, they might have useful experiences for the research. A change in a certain practice could lead to success". (Interviewee, 19)*

*"with implementing authorities, public and private ones because they implement the results not SQU. Without them SQU would not be able to achieve that part. They also can review our progress reports why are they not more into these issues, to us their opinions are very vital to our research, reviewing the proposals as well". (Interviewee, 03)*

The involvement of users allowed R&D teams to access data and exchange ideas with the implementing authorities. These teams found social and public authorities

*"are interested and they are helping us in terms of accessing the data, in terms of getting information from farmers, they have been very helpful".(Interviewee, 17).*

*"It would have been very difficult without the team we had from the Ministry, they collected the data for us and helped us getting all kind of approvals from the ministry... we sent the report to them when we finished". (Interviewee, 11)*

*"During the research, of course we have lot of kind of meetings, information sharing with the Ministry people and many people, different people". (Interviewee, 16)*

The involvement of end users provided input to research projects and introduced researchers to parties who would apply their findings. End users' acceptance of the R&D idea approved the concept and made it easier for applying the findings at later stages. Both effects enhanced the chances of

successful performance. This is emphasised in the R&D literature (Jawad, 1995; Balachandra and Friar, 1997; Cooper, 2001 and 2005; Krishnan and Ulrich, 2001; Mallon, 2002; Goffin and Mitchell, 2005; Ottenbacher et al., 2006; Johnson and Luo, 2008; Johnson et al., 2009; Buganza et al., 2010; Henard and Dacin, 2010).

The effect "*Users involvement and acceptance*" were reported by members of every group, a total of 10 (20%) out of the 50 extracts in the category "**Task/Project related effects**" (Table 6.3). That all groups of interviewees identified this effect reflects its importance to the delivery of successful academic research.

#### **6.3.2.7 Summary of category two - theme 9**

The thematic analysis of 50 extracted statements from the interviews revealed 6 implementation effects on R&D performance. They were grouped under the category "**Task/Project related effects**" as they addressed the effects related to the idea itself and/or the end result of the project. They included "*Clear objectives*", "*Project appropriateness and feasibility*", "*Multi-disciplinary research*", "*Project size*", "*Project planning*" and "*User involvement and acceptance*" (Table 6.3).

Objectives of successful projects were clear and of a multidiscipline nature. Users were involved and their acceptance of the project objectives was highly valued for a successful outcome. These projects were appropriate to the institutional strategy, feasibility, cost effectiveness and proper planning. Pilot studies reduced the risk of failure of big projects. These findings support the available literature of R&D.

AP may better appreciate the effect of the size of a research project as they progress their career. AE enabled academics to experience the benefits of proper "*Project planning*" for their projects. The rest of effects in the category "**Task/Project related effects**" were widely experienced by all groups of participants. This reflects their significant influence on R&D success.

### 6.3.3 Category three: team related effects

The category “**Team related effects**” included seven effects; “*Team composition*”, “*Researcher attitude*”, “*Researcher profile*”, “*Skills of the project leader*”, “*Other commitments of the research team*”, “*Team communication*” and “*Informed team*”, see Table 6.4. These effects resulted from the analysis of 61 extracts.

Team related effects	Extracts	Extracts by Nature of science			Extracts by Rank of researchers			Extracts by Administrative experience	
		SS N= 6	BS 7	AS 9	FP 8	MP 8	AP 6	AE 13	LAE 9
Team composition	8	3	3	2	5	3	0	7	1
Researcher attitude	9	3	3	3	3	4	2	6	3
Researcher profile	5	0	3	2	2	2	1	2	3
Skills of the project leader	15	5	3	7	7	5	3	11	4
Other commitments of the research team	9	3	2	4	3	2	4	5	4
Team communication	6	2	2	2	3	2	1	5	1
Informed team	9	4	3	2	5	3	1	9	0
<b>Total</b>	<b>61</b>	<b>20</b>	<b>19</b>	<b>22</b>	<b>28</b>	<b>21</b>	<b>12</b>	<b>45</b>	<b>16</b>

Table 6.4: Contribution of different groups to the category “Team related effects”.

#### 6.3.3.1 Effect 11: team composition

The first effect in the “**Team related effects**” was the nature of composition of the R&D team. Some participants argued that diversity in backgrounds was essential for successful research projects especially with multidisciplinary research. However the right backgrounds were needed to facilitate success, and successful project leaders selected their research team purposefully.

*“The team {was} coming from different backgrounds in addition to the involvement of the ministry people and five MSc students”. (Interviewee, 11)*

*“We got groups from different schools and department working together to be successful”. (Interviewee, 20)*

*“The team I had, three people with different backgrounds and a few MSc students”. (Interviewee, 22)*

*“Talking about the selection of the project but not only the selection of the project, it is the selection of the right people, and the people with a common goal in a mind and each one recognizes the role of an achieving this common goal”. (Interviewee, 09)*

*“You have to choose the correct team members”. (Interviewee, 09)*

Without the right people for the right research, projects did not succeed despite the presence of a supportive environment and other effects such as infrastructures and facilities.

*“You may create the environment for research but you may not succeed because you are not bringing the right people ... If a project is submitted then I make sure that the right people are here”. (Interviewee, 06)*

The right composition of research team brought different skill and disciplines to the project and contributed to successful performance. This finding supports those in the R&D literature (see Cooper, 1984 and 2001; Maidique and Zirger, 1984; Larson, 1988; Craig and Hart, 1992; Brown and Eisenhardt, 1995; Mallon, 2002; Goffin and Mitchell, 2005; Ottenbacher et al., 2006; Harmancioglu, 2007; Swink and Song, 2007; Stendahl, 2009).

The effect *“Team composition”* was indicated in 8 (13.1%) out of the 61 extracts in the category **“Team related effects”** (Table 6.4). None of the APs raised this effect but this may have been due to lack of experience.

### 6.3.3.2 Effect 12: researchers attitudes

When the R&D team lacked interest in the project there was a higher chance of failure. This questions the researchers' involvement in the work if they were not interested.

*"Contribution to failure ... can be {one of} two reasons, whether he was not interested in doing that type of work or number 2 he was not capable of doing that work".  
(Interviewee, 16)*

Another attitude problem was related to the reason for getting involved in research activities. In the academic environment, it is believed that research is essential not only for career progress but also as a message of the academics' mission in life. It was found here that some researchers at SQU had different views. They did not have the motivation to compile a research proposal and work it out afterward. A HoD, for example, attempted to encourage one of his department staff to compile a research proposal, but the latter replied

*"Why should I do research, give me an incentive".  
(Interviewee, 12)*

*"There are some very good faculties do not bother to compete. They do not bother to write decent proposals and win a grant. They do not see tangible benefits for their efforts. That's what it is ... proposals largely written by Associate Professors who want to become full Professors ... you will not find too many full Professors. (Interviewee, 03)*

The age of researchers might be a reason for this lack of interest. Whether they were senior or junior researchers, they seemed to be in early retirement. Another possible cause for this problem was lack of willingness due to teaching workloads and other excuses which showed a lack of determination to do research. Workloads had some effect however; there were some examples of successful project that did not agree with these excuses.



*“Many researchers... are about 55 years old or older. They are not interested in research”. (Interviewee, 05)*

*“Some people complain about teaching load and working hours but that is not true. Many researchers teach same number of hours and still deliver good results and outcomes, this is just an excuse ....success is something up to individuals” (Interviewee, 03)*

*“The main factor is the willingness of the research team, without it you cannot do anything at all; we overcome many problems because of our willingness and commitment to the project”. (Interviewee, 11)*

A need for some motivating incentives was stressed to overcome this problem. However, one wondered what could motivate academics other than career progression.

*“If I write a proposal and I mean it, I expect some reward at the end of the day and if I do not see the reward then I’m not going to bother about it”. (Interviewee, 03)*

*“The motivation aspect is important, which brings the incentive with it because to be motivated in research I need incentives so they go hand in hand”. (Interviewee, 21)*

*“What is the objective for me to participate in this research, my objective is to get promoted whether here or elsewhere by getting a good record of publications and research record”. (Interviewee, 05)*

*“If we ask ourselves what it is we interested in, we are interested to develop our research, what are the individuals interested in? They are interested in publishing some papers because this fulfils promotion requirements”. (Interviewee, 02)*

The effect *“Researchers attitudes”* reflected the psychology of the researchers. It was influenced by researchers’ age, motivation, workload and degree of interestedness in the project. In general, a determined research team enhanced the chances of success of a R&D project. This finding agrees with the findings

in the R&D literature. Researcher enthusiasm characterised successful research (see Mallon, 2002; Pilbeam, 2002). While successful researchers had the feeling of project's ownership, those who lacked this feeling tended to fail (Pilbeam, 2002).

The effect "*Researchers attitudes*" was raised by 9 out of the 61 (14.8%) extracts in the category "**Team related effects**", see Table 6.4. This effect was raised within all interview groups which reflects its influential role on R&D success.

### **6.3.3.3 Effect 13: researchers' profile**

Many projects failed because the members of the research team lacked the necessary skills. Young researchers failed because they over-estimated their capability to undertake large scale work. This questions the approval given to the project in the first place.

*"Contribution to failure ... can be {one of} two reasons, whether he was not interested in doing that type of work or number 2 he was not capable of doing that work".  
(Interviewee, 16)*

*"They misjudged their capability, so that is how it failed".  
(Interviewee, 18)*

A young enthusiastic researcher might struggle with his project because he thought that he would not need the support of experts and senior academics but was wrong. At a later stage he asked for support and completed his work.

*"We started with some difficulties at the beginning because I was new, and we succeeded through assistance". (Interviewee, 18)*

To limit the chances of failure, researchers' profiles are screened during proposal evaluation. Rich profiles had higher chances of success while poor profiles could be supported with, for example, involvement of experts to reduce risks of failures.

*“Look at his ability to do the work... a professor who has done research these several years and he produce excellent papers, then the chances that he will do it”. (Interviewee, 12)*

*“First of all I would look at research profile of the PI. ...If he is a person of good research, good research track record. The second criterion is discipline...did he deliver the previous project? Did he execute and provide what he promised in the project funded two years ago, 5 years ago, 7 years ago and if his past records in deliverables in completion of the project are good”. (Interviewee, 14)*

Moreover, to enhance the chances of success, senior researchers suggested that young researchers

*“Need to bring credibility of researchers from abroad we need to invite people and ask them what does take to have a project”. (Interviewee, 06)*

An experienced research team gave an R&D project a better chance of success. They were better able to handle technical and administration issues. Unlike successful projects, failed ones lacked the feature of rich “*Researchers’ profile*”. This finding is in line with the R&D literature (see Cooper, 1984 and 2001; Maidique and Zirger, 1984; Larson, 1988; Craig and Hart, 1992; Brown and Eisenhardt, 1995; Jawad, 1995; Mallon, 2002; Pilbeam, 2002; Goffin and Mitchell, 2005; Ottenbacher et al., 2006; Harmancioglu, 2007; Swink and Song, 2007; Stendahl, 2009).

The effect “*Researcher profile*” was indicated in 5 out of the 61 (8.2%) extracts in the category “**Team related effects**” (Table 6.4). No SS researcher mentioned this effect and, surprisingly, fewer academics with research experience than those without raised it as an issue.

#### 6.3.3.4 Effect 14: skills of the project leader

Some successful research projects in SQU had effective leadership. The role of the project leader or principal investigator (PI) was viewed as the main contributor to success.

*“One need sound leadership to lead you to success”.  
(Interviewee, 19)*

*“I can believe that if you have good PI, you have good project...the success of the project is as good as the ability and success of the PI... If the PI is good you have good chance of the project attention if the PI is bad there is all possibilities to fail”. (Interviewee, 09)*

Managing the team members and organising them to deliver successful performance was the responsibility of project’s leadership. Successful projects leaders were

*“responsible for everything”. (Interviewee, 14)*

*“Planning and management are important, most of the time these projects are not individual projects, they are team ones, managing the team and organizing them to work is very important”. (Interviewee, 01)*

The leadership of successful projects allowed for collaborative decisions and disputes in general but in certain situations stood and directed the team.

*“Most of the times decisions were taken collaboratively but it happens when I had to cut down the disagreements and move on. I learnt some skills to manage research teams and I think that is one main parameter in my success”.  
(Interviewee, 22)*

*“I always discuss things with the team before deciding on anything that of relations to the project, at the end of the day it is the team that conduct the project not the PI”.  
(Interviewee, 07)*

In contrast to successes, lack of effective leadership contributed to failures. Whenever a research project was left to manage itself it failed. In R&D projects, difficulties were anticipated with managing highly qualified people. This study found these difficulties resulted in some failures.

*“Research projects are failing because they are not being managed properly. Pls never write reports or do not know what his team have done”. (Interviewee, 03)*

*“Managing groups is not an easy at all”. (Interviewee, 10)*

In addition to lack of proper leadership, projects failed because of lack of project management skills. Managing projects is about managing resources and people which were skills that project leaders of failed projects often lacked.

*“Academics here are not familiar with management of research which is not like running research... Many of our senior researchers do not know that and they are not able to manage funds and manage people and groups”. (Interviewee, 06)*

In one project for example, the cause of failure

*“was not the funds...it was mainly management and knowing what to do, at the right time”. (Interviewee, 12)*

Successful researchers needed

*“to be innovative and able to manage their research project”. (Interviewee, 20)*

Project leader skills (managerial and technical) enhanced the chance of project success. Project leadership managed the team members and organised them to deliver successful performance. This finding supports the R&D literature. Successful projects had effective resources and people management as compared to failed ones (see Maidique and Zirger, 1984; Cooper and Kleinschmidt, 1993, 1995 and 1996; Jawad 1995; Balachandra and Friar, 1997; Cooper, 2001; Ernst, 2002; Mallon, 2002).

The effect “*Skills of the project leader*” was indicated in 15 out of the 61 (24.6%) extracts in the category “**Team related effects**” (Table 6.4). All interview groups identified this effect which reflects its importance to deliver successful academic research.

#### **6.3.3.5 Effect 15: other commitments of the team**

Workloads are used as an excuse for R&D failure in SQU. Failures were caused, partly at least, by lack of sufficient time allocation for research activities. Researchers had to work in their spare time to succeed which should not be the case. Most of the researchers’ time was mainly utilised for teaching and administrative work.

*“Most of the time we do our research in the spare time, teaching load”. (Interviewee, 01)*

*“We have so many things to do, course load, plus administrative duties, plus we have to manage the research projects... my main hindrance is teaching work” (Interviewee, 08)*

Lack of sufficient time allocation was a significant challenge for some current projects which may jeopardise their research performance. Research was considered as an individual responsibility while teaching was a departmental one and the latter had the higher priority.

*“I would expect my head of the department to decrease my work load”. (Interviewee, 04)*

*“Not to mention the teaching load, I have 15 hours of teaching that is 3 hours every day every week when I see some academics in my dept who do not have a single research project and teach 12 or even only 9 hours”. (Interviewee, 05)*

*“I am supposed to teach 12 hours and conduct research in addition to my admin responsibilities. I do not have the right research assistants and no postgraduate students*

*around, how could I be successful in my research". (Interviewee, 19)*

*"Teaching commitment and also there is lot of committee working". (Interviewee, 10)*

Adequate time allocation for research was one of the main effects in successful implementation of R&D projects.

*"The other factor is the time, I am teaching two courses. So we have time to give for research... we have enough time, and we have a research assistant". (Interviewee, 18)*

Successful research projects had sufficient time allocations whilst failed projects often had inadequate time for execution. This finding supports the R&D literature (see Rubenstein et al., 1976; Carter, 1982; Jawad, 1995; Balachandra and Friar, 1997; Mallon, 2002; Pilbeam, 2002).

The effect *"Other commitments of the team"* was indicated in 9 out of the 61 (14.8%) extracts in the category **"Team related effects"**, see Table 6.4. All interview groups identified this effect which reflects its important influence on success of academic research.

#### **6.3.3.6 Effect 16: team communication skills**

Internal team communications skills were identified as being influential on R&D performance in SQU. Proper internal communication helped projects succeed whereas poor communication skills contributed to lack of success. For instance, major contribution to research success was through proper and continuous communication within the team.

*"Having regular meetings that reflected all these things I see done in a good project". (Interviewee, 13)*

*"Continuous, almost daily email communication, telephone communications". (Interviewee, 14)*

*“I consult the active members in my team, they are not from the same department but they are active and we share everything related to the project”. (Interviewee, 05)*

Some research teams were formed based on their previous personal relationships. These interpersonal relations (groupism) were at risk when the team had ineffective communication.

*“Interpersonal relationship will break down, because they cannot converse with each other, they cannot agree with each other, there is no moderate influence each one thinks that I am more important than the other, communication problems... these are all things which lead to your failure”. (Interviewee, 09)*

*“Others...lack good communications with the rest of the team, I worked with one PI who liked to give orders and take decision by himself without discussing matters with his team, I left him half way”. (Interviewee, 07)*

Successful research projects tended to extend their communications beyond institutional boundaries. A researcher, for example, approached experts, authorities, social bodies and active locals in the field of his project. This cross-border communications enabled proper understanding of the problem at an earlier stage. As a result the strategic focus of the project was adjusted.

*“Unless the ordinary people can see the value of what you are working on they would not be interested in it”. (Interviewee, 07)*

In addition, society and other implementation bodies (authorities and individuals) saw the value of the research project which eased the implementation of the findings at a later stage. In an organised workshop, for instance, these parties realised the international appreciation of the project. They interacted not only with the team but also with third parties; scientists and consultants from abroad. This initiative made it easier for the team to apply their findings without any social resistance. Also it helped the team to get support from these parties for future work. A committee was formed to take the matter further and advise decision makers accordingly.



*“We brought all faithful involved in this project under one roof. We brought international experts, we brought all our researchers, and workers together, we brought government people who have taken this, Ministry people, policy makers, decision makers and then we brought the people also in it, these people could be business people, villagers, goat shelters, farmers and all this people and we have this one day workshop in four different sessions and we listen to these people, interact with each other and re-oriented our research little bit adjust to the strategic and then we continued”. (Interviewee, 09)*

*“Once we finished...we said we are bringing the international audience but we are going to through our project to them for one whole day and they are going to listen and they are going to tell us how we have performed what we have done and where to go and all that so at the end of day we have lot of recommendation and conclusion... the ministry has seen our recommendations and conclusion”. (Interviewee, 09)*

Effective communication skills (within the team and external to it) enhanced the chances of R&D project success. These communications enabled proper understanding and execution of the problem. This finding confirms those of the R&D literature (see Rothwell et al. 1974; Rubenstein et al., 1976; Allen, 1977; Souder and Chakrabarti, 1978; Booz et al., 1982; Souder, 1987; Craig and Hart, 1992; Balachandra et al., 1996; Balachandra and Friar, 1997; Ernst 2002; Pilbeam, 2002; Goffin and Mitchell, 2005).

The effect *“Team communication skills”* was indicated in 8 out of the 61 (13.1%) extracts in the category **“Team related effects”**, see Table 6.4. All groups of interviewees identified this effect which reflects its significance to the delivery of successful academic research.

### **6.3.3.7 Effect 17: informed team**

An informed team guided by experts in the relevant field influenced the likelihood of success. For example, a researcher brought experts, in the field,

into a workshop and obtained collective directives for his project. Another researcher was in continuous contact with experts in the field of his research in order to succeed in his project.

*“We brought international experts”. (Interviewee, 09)*

*“We contacted regularly with world expertise in our field”.  
(Interviewee, 14)*

The advice by project consultants led to effective management of the business sectors involved in the project. This, in turn, assisted the delivery of successful output. For example, a candidate used a model in his research and maintained contact with the owner of the model. Comments from the experienced owner were very helpful to deliver a successful project.

*“The advices given by our international... consultant if you like were of great help they opened our eyes and enlightened the team, especially on how to go about involving the business sector”. (Interviewee, 22)*

*“We were in contact with the owner of the test {name of the owner}. He sent us few comments from his experiences which were very helpful”. (Interviewee, 11)*

Researchers' knowledge of intellectual property was of significance for project success. In one of the projects the team and the institutions lost the opportunity to copyright the software produced. After publishing, they came to know about the importance of the protection of intellectual property.

*“It was published in the journal. Now they cannot copyright it”. (Interviewee, 18)*

Researchers needed some training, guidance and consultation on this matter.

*“Researchers could have been trained...we need guidance, we need some help, we need somebody to work with us on that area. What does the process involve? And how they work with the researchers or research groups and then maybe we can also benefit”. (Interviewee, 08)*

A team informed by experts in the field, enhanced the chances of R&D success. It brought to the projects the skills and expertise that otherwise might be lacking. This finding is in line with the findings of Information Technology Acquisition (ITA) literature (see Carter, 1982; Jawad, 1995; Mallon, 2002). Jawad (1995), for example, found that use of consultants improved the success of ITA projects.

The effect "*Informed team*" was indicated in 9 out of the 61 (14.8%) extracts in the category "**Team related effects**", see Table 6.4. The importance of this effect to R&D success was referred to by all groups of interviewees.

#### **6.3.3.8 Summary of category three - theme 10**

The thematic analysis of 61 extracts resulted in seven "**Team related effects**". This category included; "*Team composition*", "*Researcher attitude*", "*Researcher profile*", "*Skills of project leader*", "*Other commitments of the research team*", "*Team communication*" and "*Informed team*". These effects influenced the performance of R&D.

The right team composition and the correct researchers' attitude and profiles were the first requirements for a successful project. The team needed a skilful project leader who used project management skills to manage his/her team. Project leadership also reduced the risks of "*Other commitments of the research team*" and improved "*Team communication*". At certain stages the team needed to involve external experts and enhance team awareness of intellectual property issues (Table 6.4). The findings of this category support the findings of R&D literature.

No AP identified "*Team composition*" which may suggest that researchers at this level work on their own, or come to appreciate this effect as they progress in their career. SS researchers did not experience the influence of "*Researchers' profile*". The rest of implementation effects in the category "**Team related effects**" were common among all groups of interviewees.

### 6.3.4 Category four: organisational effects

This category resulted from thematic analysis of 103 extracts. It included 9 effects; “Organisational culture”, “Management commitment and support”, “Administrative support”, “Clear and flexible rules”, “Evaluation process”, “Monitoring”, “Availability of resources”, “Availability of infrastructures” and “Availability of valid data” (Table 6.5). These were grouped into the category “Organisational effects”.

Organisational effects	Extracts	Extracts by Nature of science			Extracts by Rank of researchers			Extracts by Administrative experience	
		SS	BS	AS	FP	MP	AP	AE	LAE
		N= 6	7	9	8	8	6	13	9
Organisational culture	7	2	2	3	5	1	1	6	1
Management commitment and support	15	6	2	7	6	4	5	10	5
Administrative support	15	3	6	6	6	3	6	9	6
Clear and flexible rules	7	2	2	3	3	2	2	4	3
Evaluation process	8	1	3	4	2	3	3	5	3
Monitoring	16	6	5	5	7	6	3	10	6
Availability of resources	16	2	6	8	5	6	5	11	5
Availability of infrastructures	11	1	4	6	3	5	3	6	5
Availability of valid data	8	3	3	2	4	2	2	5	3
<b>Total</b>	<b>103</b>	<b>26</b>	<b>33</b>	<b>44</b>	<b>41</b>	<b>32</b>	<b>30</b>	<b>66</b>	<b>37</b>

Table 6.5: Contribution of different research groups to the category “Organisational effects”.

#### 6.3.4.1 Effect 18: organisational culture

The culture of the organisation was indicated as influencing R&D performance. Competition, for example, was identified as important for research success by some interviewees. It improved the quality of research projects awarded. Lack of competition resulted in approval of low quality projects. These projects, in many cases, failed.

*“A lack of competition”. (Interviewee, 03)*

*“No enough projects to compete to make that as a success”.(Interviewee, 09)*

*“We need competition ... Internal grant still they are not really competitive and the even the level of competition in HM proposals are relatively low”. (Interviewee, 14)*

*“The amount of funds for research fit the submitted proposals so it is rare for a proposal to be turned down”. (Interviewee, 02)*

Another highlighted element of organisational culture was the readiness of academics to listen to each other. Research discussions between academics enriched research outcome. Besides the new ideas given to the team there were all kind of inputs and potential collaboration from others. For example, failure could have been avoided had the team listened to their colleagues in the institution.

*“We don’t have time to set and talk science”. (Interviewee, 03)*

These internal scientific discussions did not have to be in person. Circulation of paperwork also opened windows for others’ input and possible improvements.

*“I’ll send you the copy of my paper and send other copy to colleagues of mine to have a look at it. I expect opinions. I certainly I would discuss my research with my colleagues”. (Interviewee, 04)*

*“We need to have that fire of scientific curiosity, do not have to be in my field”. (Interviewee, 21)*

Because of these discussions, some research projects had better chances for success than others. Two teams collaborated and exchanged knowledge and technology which helped them to overcome some shortfalls with the resources and timings.

*“Our project crossed over with another HM {SR} project right, we borrowed the technology of water treatment from them. Then we talked with the people and we told them that we will build a treatment plant if you permit us to put into your property then we will clean this water for you then you can use it. In one minute, they agreed”. (Interviewee, 09)*

“Organisational culture” was found influential; through a competitive environment and internal discussions. This finding supports those in the R&D literature. Competition ensured better quality research proposals and contributed to successful performance (Balachandra et al., 1996; Balachandra and Friar, 1997; Mallon, 2002). Internal scientific discussions could compensate for a project’s shortfalls in terms of resources and ideas. Pilbeam (2002) emphasised the importance of collaboration for academic research. However, internal collaboration i.e. between projects within the same institution is newly identified here.

The effect “Organisational culture” was indicated in 7 out of the 103 (6.8%) extracts in the category “**Organisational effects**” (Table 6.5). This effect was widely experienced by all groups of interviewees which suggest an influential role on R&D success.

#### **6.3.4.2 Effects 19: management commitment and support**

Committed management that believed in the project and advanced it through the organization with great personal commitment and support considerably enhanced a project’s chances of success. Successful projects had more

commitment from management which helped ensure sufficient resources and advancement of the project. On the other hand, unsuccessful projects did not enjoy such advancement from management. Two researchers, for example, referenced their project failures to lack of management commitment and support. They complained that they

*“need management commitment”. (Interviewee, 19)*

*“Commitment from the university to provide the support and to fund {it}”. (Interviewee, 12)*

Should they had it, they would have been successful, in their opinions.

Committed management ensured allocation of sufficient resources to R&D projects. It also helped individuals to overcome internal institutional barriers. Researchers who had experienced failure claimed that they had needed support

*“in terms of ordinary things like space, an additional room, more laboratory space, for example keeping the laboratories open after normal working time”. (Interviewee, 04)*

Should they have these supports, they believed their project would have been more successful. This conclusion was further informed by some success cases. Some researchers succeeded because they had all the support they needed from their management.

*“The HoD and college support was essential in many occasions”. (Interviewee, 07)*

*“The support, the environment, the support from everybody, the support from the people, Vice Chancellor’s office was also very good”. (Interviewee, 08)*

Management commitment to advance research through the organization, and its support ensured sufficient R&D resources and assisted researchers to deliver successful performance. This finding supports the R&D literature (see

SPRU, 1972; Jawad, 1995; Brown and Eisenhardt, 1995; Balachandra and Friar, 1997; Ernst, 2002; Mallon, 2002; Pilbeam, 2002).

The effect *“Management commitment and support”* was indicated in 15 out of the 103 (14.6%) extracts in the category **“Organisational effects”**, see Table 6.5. All groups of interviewees identified this effect which reflects the significant role it had on the success of their academic research.

#### **6.3.4.3 Effects 20: administrative support**

One of the effects identified in this study was the need for strong and efficient *“Administrative support”*. The support by research administration represents administrative and logistic activities that are provided by the institution in order to help the researchers without being part of the research projects themselves (Kirkland, 2005). Effective administration assisted researchers to deliver successful projects. For example, a researcher owed his success to

*“Effective system that is bylaws, process and procedures”.*  
(Interviewee, 19)

*“Can facilitate {administrative requirements} more through the university administration”* (Interviewee, 13)

*“Administrative support”* for academic research was relatively frequently mentioned as an effect for success. The availability of this support was one of the contributors to project success.

*“We have all sorts of support, institutional support, administrative support”.* (Interviewee, 18)

Despite the availability of positive effects related to the research team, the lack of a supportive administrative environment caused failure. Even high calibre researchers failed in this kind of environment.

*“You could be a very good researcher but the university doesn’t support you fully. I want to order chemicals but it takes six months”.* (Interviewee, 12)



While successful research was supported administratively, failed projects lacked this support. Administrative requirements such as accounting and finance were extra loads for academics. For example, the long time required to process a purchase of only a small amount hindered success. *“Delivery of promises”* within time were sometimes delivered at extra cost.

*“Fund management is horrible, because money is given, sometimes it is generously given but, the access to money is denied, that should not be case...I should not be fighting for a buying CD or a brand of CD diskette, a printer cartridge. For everything, I should not get fighting ... fund management is not good at all”. (Interviewee, 09)*

*“The main problem that I faced was the procurement, it was not easy to procure even small things for the research”. (Interviewee, 07)*

*“{The researchers} has to fill 3 forms and get approval from 5 places”. (Interviewee, 09)*

*“Administrative support”* was also required to fill the gap between administration staff and academics. In SQU, the two communities used different languages and a researcher struggled with administrative requirements until he managed to speak the administration’s language.

*“I also had some problems with administration because they talk a different language but I learnt their language and now this is easier. The main problem that I faced was procurement. It was not easy to procure even small things for the research”. (Interviewee, 07)*

Supporting activities such as marketing and legal affairs were needed in some professional jobs. A researcher failed to market his discoveries because he lacked the skills and he did not find the support from administration.

*“Public relations, which should have been activated 10 years ago, try to sell some of our ideas...marketability and do not expect someone to do it if he does not know what the market looks like and if you expect researchers to do*

*that it would be too much, if you have an office to do that kind of things to support the process". (Interviewee, 21)*

Effective research “*Administrative support*” enabled smooth fulfilment of formalities and provided administrative and commercial support. This effect assisted researchers to deliver successful performance. R&D literature has tended to overlook this effect, however the literature of Higher Education has addressed it (see Connell, 2004; Hazelkorn, 2005; Kirkland, 2005; Pilbeam, 2008).

The effects “*Administrative support*” was indicated in 15 out of the 103 (14.6%) extracts in the category “**Organisational effects**” (Table 6.5). Interviewees from all groups identified this effect. This wide experience reflects the significant influence of this effect on R&D success.

#### **6.3.4.4 Effects 21: clear and flexible rules**

“*Clear and flexible rules*” was one an implementation effect mentioned here. SQU has a centralised procurement system which is very complicated compared to the petty cash requirements. The latter are clear and easy to follow while the former are not. Researchers did not have problems with petty cash procurements whereas they had many with the centralised system.

*“I never had a serious problem with the petty cash, I know there are rules that petty cash cannot be more than a certain limit, but if we know the rule that we have to live with and we follow the rules we should not have problems”. (Interviewee, 02)*

Inflexible rules and regulations jeopardised the success of research projects. The rigidity was not helpful in an unpredictable environment such as R&D.

*“There should be much more flexibility. First of all let’s start with the process, because it takes too long time”. (Interviewee, 17)*

*“I cannot blame people, we have to fine tune the system”. (Interviewee, 09)*

*“Somebody joins in September, he has already missed the deadline to submit the project for next year .... He has to wait for one year and 4 months”. (Interviewee, 15)*

Clear and flexible rules assist researchers to adapt to uncertainties as and when they arose which increased the chances of R&D success. This finding supports the findings of Jawad (1995). Clear and flexible rules contributed to the success of ITA projects.

The effects *“Clear and flexible rules”* was indicated in 7 out of the 103 (7.8%) extracts in the category, **“Organisational effects”** (Table 6.5). All groups of interviewees identified this effect which reflects its importance to R&D success.

#### **6.3.4.5 Effect 22: evaluation process**

The evaluation of research proposals was very important for project success. Reviewers should be experts in the field of the proposal. They were expected to give absolute feedback about the project in terms of its appropriateness and feasibility. Reviewers' comments helped effective R&D evaluation.

*“Reviewers' comments are very important”. (Interviewee, 01)*

Evaluation in this study was approached from two dimensions; internal and external. The former represented the administrative assessments done by schools and department heads. Once projects were approved, researchers assumed that their ideas met institutional criteria. This review directed the projects on the success path that the institution had drawn.

*“{Evaluation} was never done in great depth...The CRC committee evaluates all the proposals to make sure that they meet the guidelines and funding requirements, to make sure that the research is not duplicated”. (Interviewee, 02)*

*“Research objectives should be evaluated prior to approval”. (Interviewee, 12)*

*“Our role was to check if the proposals are complete for further process... to check if the forms are complete, all data required are available to see if the proposals are ready for evaluation by referees or not. I personally think that many of those proposals should not have been funded.... One proposal did not reference a similar project that was done in the college, we told them at least give him a chance to look into this and propose again, they did not the proposal was sent for refereeing and it was funded, what do you expect the outcome would be”.*  
(Interviewee, 11)

The second dimension of evaluation was external. This referred to the peer reviews of proposals.

*“The external reviewer should be of the expert in that field and should give an absolute feedback about the appropriateness of the proposal, the feasibility of the project, whether the objectives are obtainable.”*  
(Interviewee, 02)

Researchers believed that the peer reviews criticised their ideas, methods, etc... An interviewee, for example, assumed that these reviews were supposed to answer his questions

*“Am I asking the right question? Is my method clear? Is my method of obtaining data is correct?”* (Interviewee, 09)

Pre-award reviews of proposals ensured quality research proposals and increased the chances of successful performance. R&D literature has addressed project selection as a means to improve R&D performance (see Griffin and Page, 1996; Cooper, 2001 and 2005; Goffin and Mitchell, 2005; Herzberg, 2006; Harmancioglu, 2007). The literature of Higher Education also addressed the issue in a similar vein (see Arnold and Balázs, 1998; Geuna and Martin, 2003; Abramo, 2008).

The effect *“Evaluation process”* was indicated in 8 out of the 103 (7.8%) extracts in the category **“Organisational effects”** (Table 6.5). All groups of

interviewees identified this effect which reflects its importance to the success of academic research.

#### **6.3.4.6 Effect 23: monitoring**

The role of the administration includes controls and monitoring of research projects which need to be monitored in order to ensure their success. Control and continuous monitoring by administration contributed to the success of research projects. In one successful project, for example, regular reviews made the research team conscious about the milestones they had to deliver. Projects

*“should not be left without monitoring by administration”.*  
(Interviewee, 07)

*“We were forced actually to meet, to present the results of our research twice a year to a committee and deliver our results regularly it was a great discipline factor...good monitoring of our progress in the project...was the major cause of success”.* (Interviewee, 14)

In general, the process at SQU of monitoring R&D projects was inefficient. The process assumed that submitted progress and annual reports were reviewed by research committees. This did not happen at all levels in SQU. A researcher, for example, questioned the process as he had never heard about a single report being returned to a researcher.

*“Every PI has to submit an annual report using a certain form, so the PI fills the form, the form then is reviewed by members of the CRC, based on that review the money of next year is released. I never had an annual review that was turned down and I’m not aware that any one was”.*  
(Interviewee, 02)

Progress reports were reviewed internally by the CRC but mostly the members of these committees were not familiar with the field of the reports they reviewed. They were not in a position to give proper evaluations of these reports. To enhance the chances of success, progress reports should have been given to experts in the field to evaluate. Comments of reviewers were of significance to

researchers. Progress reports should indicate completion percentage as researchers would know better than anybody else the progress of his research.

*“By giving these reports to experts you have better chances for success for good monitoring for integrating research efforts in the whole university”. (Interviewee, 03)*

*“We rely on administration to evaluate our research and they know nothing about the field of the study. They should leave the scientific community to monitor itself”. (Interviewee, 06)*

*“During the process rather than until the end of the process”. (Interviewee, 12)*

Administration should

*“clearly ask for the percentage of achievement 70, 80, 90% or 100% of objective has been achieved or not and why this objective. If it is achieved, explain how, and if it is not achieved, then he should explain what are the reasons”. (Interviewee, 17)*

*“What he has done in the last year and if there is a problem why was it and what is he going to go about it. What he achieved of what he promised and what he could not, based on the progress so far. I would be interested to see how much he spent on what... is there any potential break through maybe a patent is coming up or copyright”. (Interviewee, 22)*

Monitoring of research progress ensured timely and quality completion of the project's milestones. This increased the chances of successful performance. This finding supports the R&D literature (see Rothwell et al., 1974; Rubenstein et al., 1976; Cooper, 1981, 2001 and 2008; Pinto and Slevin, 1987; Merrifield, 1988; Jawad, 1995; Mallon, 2002; Pilbeam, 2002; Harmancioglu, 2007).

The effect *“Monitoring”* was indicated in 16 out of the 103 (15.5%) extracts in the category **“Organisational effects”** (Table 6.5). All groups of interviewees identified this effect which reflects its importance for successful R&D.

#### 6.3.4.7 Effect 24: availability of resources

Unless projects are resourced properly one cannot expect them to be successful. Successful research projects had sufficient funding and were well resourced.

*“You expect me to give you good results when I’m not funded enough”. (Interviewee, 06)*

*“Another factor is funding without it there will be no work done, we will not be able to hire people”. (Interviewee, 11)*

*“To be successful you need funds”. (interviewee, 19)*

*“I published 21 Papers all because of funding”. (Interviewee, 22)*

*“It had it lot of resources”. (Interviewee, 10)*

*“We have no shortage of funding, and funding is there. We have no shortage of equipment, and equipment is there or if we want to purchase it, we can purchase it, there is no problem with the equipment”. (Interviewee, 16)*

In contrast, failures occurred because projects were not provided with sufficient resources. Budgets were cut in half while performance was measured against original proposals. This, it was argued was not a problem for small size and pilot projects, but was for larger ones.

*“We realized the scope of this work was much larger than we envisaged... Actually the funding we required was not given to us in full, we got only 50% of the funding we expected, therefore we had to sort of tailor-make this project to suit the funds available and cut down on some aspects which is not satisfactory... funds are very important, funds becoming the limiting factor”. (Interviewee, 09)*

*“Funding is not a problem for small projects but it is for big projects”. (Interviewee, 06)*

*“They cut it from RO. 10,000/- to RO. 4,300/- more than 60% when they gave to us, we said, what can we do”. (Interviewee, 18)*

One of the colleges had a strategy to boost shortages of funding within certain limits. This strategy enabled researchers to overcome resources problem, to some extent. They managed to perform well, as a result.

*“I had once a shortage of fund on one of my projects, the college helped me with some funds, so these contingency funds at the college are important”. (Interviewee, 11)*

Research is an intellectual activity, therefore

*“it is heavily depended on human resources”. (Interviewee, 15)*

The university was seen to be responsible to find the right people for whatever it intended to achieve. National policies and research priorities assisted SQU to anticipate the future and work out its research strategy. But without skilful researchers in the fields specified by the research priorities success was still far from attainable.

*“It is the university’s responsibility to find those new brains that could be used to solve national problems”. (Interviewee, 20)*

The influence of availability of non-academic human resources on the outcome of R&D was stressed. Academics were busy and to do research successfully they needed research assistants, technicians and postgraduate students.

*“We are all busy and research increasingly is not done by academics it is done by postgraduate students, research assistants etc. so anything that makes this easier will improve the research in our college”. (Interviewee, 02)*

*“Faculties are busy with teaching, admin, meetings etc... they spend probably 20 -25% of their time in research but PhD students will spend 100% time on research”. (Interviewee, 06)*



*“Research assistants, some of them are top level, so involve people... full time Researchers, Doctors and Professors”.*(Interviewee, 10)

In some research projects, the research team needed funds to hire human resources, but even with the availability of sufficient funding, SQU was not able to hire the right people due to market shortages. Consequently failures occurred.

*“We need funds more to hire people than to buy equipment. We mostly need research assistants”.*  
(Interviewee, 11)

*“We need I mean manpower. Of course in the beginning I was thinking that I could hire good students or research assistants. But, later I found out that it is not so easy to get good people”.* (Interviewee, 16)

*“Recruit research assistants for continuity of collecting the data working for the topic, if you recruit a research assistant for 3 months then you have to hire another research assistant who doesn't have no single idea about what has been done. So, you have to re-train him etc... Failure is the problem of lack of skilled personal. This is the major problem we are suffering in this University without having qualified research assistants to do the job. We cannot carry the work from A to Z ourselves”.*  
(Interviewee, 17)

Here another issue came to the surface; the influence of the quality of human resources. For example, some of the projects suffered because lab technicians were not trained to work with postgraduate students and full-time researchers, they were used to working on small scale projects run by undergraduate students.

*“Our technicians most of them they are trained for undergraduate type work, they are working in lab experiments to under graduate students; they are not trained for the work to be done in the field at a full scale or doctoral or master's degree level research”.* (Interviewee, 16)

*“I do not have the right research assistants and no postgraduate students around, how could I be successful in my research”. (Interviewee, 19)*

The same problem applied also to academic posts. In SQU many if not most research active academics are expatriates who may leave SQU at any time. Projects ended up in the hands of someone who was not expert and projects failed or were terminated before completion.

*“SQU academics are more than 60% expatriate there is always the risk of researchers leaving and research being jeopardized. In these circumstances either terminate the project or modify its objectives to suit another member of academic staff, in both cases there is waste of resources”. (Interviewee, 20)*

The availability of sufficient resources and funding was influential on R&D outcomes. This finding supports the findings of R&D literature. Lack of proper funding (see Jawad, 1995; Cooper, 2001; Ernst, 2002; Mallon, 2002; Pilbeam, 2002; Ottenbacher et al., 2006) and human resources (see Mallon, 2002; Pilbeam, 2002; Ottenbacher et al., 2006) jeopardised R&D success.

The effect “*Availability of resources*” was indicated in 16 out of the 103 (15.5%) extracts in the category “**Organisational effects**” (Table 6.5). All groups of interviewees identified this effects which reflects its important influence on R&D success.

#### **6.3.4.8 Effect 25: availability of infrastructure**

To deliver successful research projects, researchers needed a research infrastructure. Some failures, or at least incomplete successes, occurred because of lack of infrastructure. A researcher, for instance, had to train some students to do material casting themselves because of a lack of a casting workshop at the university. The availability of a casting workshop in SQU could have enabled better results for this research and for teaching as well.

*“There is no casting shop in our University... I just visited the student groups and we sat and made plans. We sent the students to Amiantit Oman {material casting company} for half a day’s basic training then they come back and then everything was done by the hand with the students and the Supervisor”. (Interviewee, 15)*

Other researchers considered they would have developed much better results if they had the support of a better infrastructure. To succeed in research SQU

*“has to improve the infrastructure facility”. (Interviewee, 09)*

*“Need infrastructure”. (Interviewee, 19)*

*“Need to have a good set up, that include everything, researchers, facilities, system, infrastructure”. (Interviewee, 21)*

*“Infrastructure at SQU doesn’t allow for large size projects as yet, if we want to do large size or bigger scale projects, we need to have an infrastructure”. (Interviewee, 16)*

*“If you want to do the state-of-the-art research, you need a state-of-the-art facility”. (Interviewee, 15)*

Limited or zero access to required facilities caused, even in the best cases, delay of project completion. SQU has increased both student numbers and academics, but with no additional space. Researchers assume the availability of space and access to facilities on approval of proposals by their department and schools.

*“We did very little from 1994 to 1999 simply because of lack of facilities”. (Interviewee, 12)*

*“The college has grown in the last ten years in terms of student intake by 300% but not in terms of space”. (Interviewee, 02)*

Availability of the right infrastructure contributed to R&D success. This finding is in line with the findings reported in the R&D literature (see Jawad, 1995; Cooper, 2001; Ernst, 2002; Mallon, 2002; Pilbeam, 2002; Ottenbacher et al.,

2006) and Higher Education. Success in state-of-the-art research needs state-of-the-art facilities (see Connell, 2004; Hazelkorn, 2005).

The effect *“Availability of infrastructure”* was indicated in 11 out of the 103 (10.7%) extracts in the category **“Organisational effects”** (Table 6.5). All groups of interviewees identified this effect. This indicates the important influence of this effect on R&D success.

#### **6.3.4.9 Effects 26: availability of valid data**

Data is a major element in R&D, without it researchers would not be able to process anything. Lack of actual data decreased the chance of success in some cases at SQU. Success in research

*“Need actual data”. (Interviewee, 05)*

*“Most important factor is access to information”.  
(Interviewee, 20)*

Some researchers used collaboration with locals and authorities to access actual data in order to deliver their promises. They believed that researchers

*“will not get good data without good collaboration”.  
(Interviewee, 07)*

With this collaboration they managed to get the data they needed. Locals and authorities

*“supported us fully in terms of data”. (Interviewee, 14)*

They

*“are helping us in terms for accessing the data, in terms of getting information from farmers, they have been very helpful”. (Interviewee, 17)*

In the same vein, a related problem was that a researcher might access data but then find themselves holding invalid data. They had collaborated to

overcome barriers and get access to data but only to find the data was not valid. This problem complicated the success mission for SQU researchers.

*“We have a problem over here that is not only we do not have data available for research but also this data is not validated most of the time”. (Interviewee, 22)*

*“Who will validate the data, I can bring them a model but how to validate the data and the results”. (Interviewee, 05)*

The question, most of the researchers, had was who

*“can provide us with validated reliable data”. (Interviewee, 22)*

Lack of valid data decreased the chances of success of R&D project. This finding confirms the findings of Jawad (1995).

The effects *“Availability of valid data”* was indicated in 8 out of the 103 (7.8%) extracts in the category **“Organisational effects”** (Table 6.5). All groups of interviewees identified this effect which reflects its important role in the success of academic research at SQU.

#### **6.3.4.10 Summary of category four - theme 11**

This thematic analysis of 103 extracts revealed 9 implementation effects on the performance of academic research. These included *“Organisational culture”, “Management commitment and support”, “Administrative support”, “Clear and flexible rules”, “Evaluation process”, “Monitoring”, “Availability of resources”, “Availability of infrastructures” and “Availability of valid data”*. These were grouped into the category **“Organisational effects”**.

*“Organisational culture”* contributed to R&D success. A competitive environment reduced the chances of low quality research. Internal scientific discussions and cross-project collaboration enriched research projects and assisted researchers to overcome resource limitations. *“Management commitment and support”* provided R&D project with necessary guidance and sufficient funding to

succeed. “Clear and flexible rules” enabled effective “Administrative support” which allowed research teams to focus on the technical side of their research. R&D “Evaluation process” and “Monitoring” ensured fulfilment of “Project” and “Team” related effects. The “Availability of resources”, “Availability of infrastructures”, and “Availability of valid data” provided smooth and successful R&D execution. The effects in the category “Organisational effects” were widely experienced by all groups of interviewees which reflect their important influence on the success of R&D at SQU.

**6.3.5 Category Five: behavioural effects**

Behavioural influence on the success of research project was fairly strong. Researchers believed that

*“personnel behaviour is effecting not only... research at the institution but also the teaching process in the departments and the colleges. (Interviewee, 22)*

Behavioural effects	Extracts	Extracts by Nature of science			Extracts by Rank of researchers			Extracts by Administrative experience	
		SS	BS	AS	FP	MP	AP	AE	LAE
		N= 6	7	9	8	8	6	13	9
Motivation	10	3	4	3	5	1	4	8	2
Organisational leadership	15	5	3	7	6	4	5	10	5
Conflict	7	2	1	4	2	2	3	6	1
Politics	8	3	2	3	4	1	3	4	4
<b>Total</b>	<b>40</b>	<b>13</b>	<b>10</b>	<b>17</b>	<b>17</b>	<b>8</b>	<b>15</b>	<b>28</b>	<b>12</b>

Table 6.6: Contribution of different research groups to the category “Behavioural effects”.

This category discusses the effects related to individual behaviour. “Behavioural effects” includes four effects; “Motivation”, “Organisational leadership”, “Conflict” and “Politics”. These effects were derived from the thematic analysis of 40 extracts (Table 6.6).

### 6.3.5.1 Effects 27: motivation

Researcher needed “*motivation*” through incentives to undertake the burden of research projects. In general terms

*“Faculties {academics} will need an incentive ...I make sure that everyone is getting something from the project”.*  
(Interviewee, 03)

Successful researchers emphasised the need for a rewarding system or incentives as “*motivation*” for future success. Academic rewards such as conference attendance and new research projects were suggested. In addition, personal monetary incentives were indicated.

*“I believe successful researchers should be given more than one conference every year and they shouldn’t have to pay for half of that from their own pocket which is the situation in reality at this moment...Some funds to reward successful research”.* (Interviewee, 13)

*“Motivation aspect is important, which brings the incentive with it because to be motivated in research I need incentives so they go hand by hand”.* (Interviewee, 21)

*“We have money for the Assistants but no money for the researchers”* (interviewee, 18).

*“Researchers should be given a reward like 10% of the project cost if they finish in time and within budget”.*  
(Interviewee, 11)

It was suggested by some interviewees that in addition to incentives, there should be penalties as a means of “*motivation*”. Absence of punishments provided a secured career for academics. This in turn de-motivated the successful ones in the long term. Consequently less research competition occurred. Reinforcement of unsuccessful performance was emphasised through the SQU human resources system. An integrated process of researchers profile and their contracts renewals was recommended.

*“We have two major problems first there is no incentives for motivations and in return there is no punishment”. (Interviewee, 19)*

*“There is no punishment for those who fail”. (Interviewee, 14)*

*“There is another issue which is when personnel dept renew their employment contract they do not take into account the person's research records, so why should he be bothered”. (Interviewee, 05)*

*“People don't compete is largely because people feel secure in their jobs. Their jobs are not threatened... You cannot touch anybody. You cannot reprimand anybody. If you reprimand anybody, you will become a bad guy. If I call associate professor, look man you are not doing well. I will be bad guy... It is applicable right across the university... There has to be some stick in the system. You have carrots in the system there has to be some stick”. (Interviewee, 03)*

*“At the end of the day I don't have any accountability. Why I am bothered?” (Interviewee, 09)*

Lack of incentives and penalties decreased researchers' *“motivation”* which limited the chances of success of R&D project. The R&D literature has addressed the effect of incentives for motivating R&D personnel (see Rothwell et al., 1974; Ernst, 2002; Goffin and Mitchell, 2005). The effect of penalties, however, is newly derived here.

The effects *“Motivation”* was indicated respectively in 10 out of the 40 (25%) extracts in the category **“Behavioural effects”** (Table 6.6). All groups of interviewees identified this effect which reflects its significance to R&D success.

### **6.3.5.2 Effect 28: organisational leadership**

The importance of *“Organisational leadership”* to motivate and encourage researchers was indicated. Leaders simplified major challenges in the eyes of the researchers and boosted their performance.



*“See one department active in research and you find that it is active because of the HoD”. (Interviewee, 19)*

Researchers needed motivation not only from the nature of their work, but also from the people they work for and with. Lack of encouragement by leaders created obstacles in the process and threatened R&D performance. Negative responses, for example, adversely affected the commitment of individuals to research. Non-committed researchers were not expected to deliver successful research projects.

*“If my head of the department encourages me to do these research if he or she is convinced that the research I’m doing is going to benefit the department and the student population and the academic population at large I would expect the sort of help, that sort of encouragement, okay”. (Interviewee, 04)*

*“I wanted some help with but the chairman did not want me to talk about them {problems}, he said everyone has some problems with their research, that is the researcher’s job to sort out...that answer was not helping SQU research, it was another way to say do not carry out any research in the future”. (Interviewee, 05)*

Candidates who had positive experience of “Organisational leadership”, either as leaders or researchers, informed this belief. Researchers worked hard on their research often because they were motivated by their leaders. They behaved this way because they believed that

*“when you work for your staff they will work for you”. (Interviewee, 06)*

For example, HoD behaviour influenced researchers at the department and with encouragement the number or research project improved tremendously.

*“Many of the researchers tried once and had some problems and stopped so I had to motivate them. I had to support the active ones... I focused on those that had research calibre, I worked with them on their proposals, assisted them to overcome their problems, at the*

*beginning I met with each one and motivated them to come with their ideas and took it from there. I advised them on team formation and which organization to collaborate with. Now almost everyone in the dept has at least one project and they see the difference before and after... In the 2<sup>nd</sup> year of my time as HoD, we proposed 2 projects, in the 3<sup>rd</sup> we proposed 7 out of 8 proposed by the college". (Interviewee, 11)*

Some leaders gave example for their departments and schools. They spent as much time on research as anyone else, if not more. Others assisted academics to fulfil the formal requirements as a way to support them.

*"When a PI would want to submit a proposal he would come and discuss it with me, then it can be fine tuned or modified then submitted". (Interviewee, 02)*

*"I do research as much as the rest do". (Interviewee, 06)*

Positive "Organisational leadership" took the ownership of the department. Different methods were used by leaders to overcome certain shortages. For example, a department was short of resources to organise a conference. The HoD approached external bodies for donations and did not wait for the institution to provide them.

*"I was short of money for one of the conferences I had to beg for money from the research council, companies and others. all that would not happen if I had not assumed the ownership of the department". (Interviewee, 06)*

Less successful researchers and young researchers also confirmed this argument. They needed support, guidance and directives from their "Organisational leadership" more than others. A researcher, for example, had some logistics and administrative challenges. Unfortunately the negative behaviour of his leaders threatened the performance of his project.

*"Younger researchers... need guidance, directions motivation encouragement etc.. You expect them {the dean, the HoD} to help you if there are any obstacles... I*

*had some administrative obstacles which they did not assist me in overcoming... I expected them to encourage me to do research". (Interviewee, 01)*

Researchers expected their leaders to appreciate their involvement in research. Appreciation in terms of decrease in other workloads could have enabled them to give more time to research and produce much better results.

*"I would expect my head of the department to decrease my workload...If my head of the department encourages me to do these research if he or she is convinced that the research I'm doing is going to benefit the department and the students population and the academic population field at large I would expect the sort of help that sort of encouragement". (Interviewee, 04)*

While "Organisational leadership" enhanced researchers' performances in some areas of SQU, there were academics who claimed the opposite experience. Negative "Organisational leadership" stopped an academic from conducting research for many years because of animosity between the two. An opportunity of success was lost because of the leader's behaviour.

*"A colleague who has left now was stopped by the HoD for a number of years from doing research on certain areas that he was interested in. His interests were appropriate to Oman and he is an outstanding researcher. SQU lost that opportunity because these two individuals came from two countries that have long history of wars". (Interviewee, 02)*

A researcher who failed in one of his projects could not give enough time to his research because of other workloads. He did not find the help he expected from his leader.

*"I tried to discuss this issue with the HoD and explained to him that because of my research project I cannot work 15 hours a week. You know what he said, he said do not talk about your project that is your choice. What kind of HoD says this while he gives other who do not have research load 9 hours per week". (Interviewee, 05)*

Effective leaders' created the necessary enthusiasm in the process which boosted R&D performance. R&D literature has ignored this effect; however, Higher Education literature has addressed it (see Middlehurst and Kennie, 1995; Connell, 2004; Middlehurst, 2004).

The effect "*Organisational leadership*" was indicated in 15 out of the 40 (37.5%) extracts in the category "**Behavioural effects**" (Table 6.6). All groups of interviewees identified this effects which reflects its importance to the success of academic research.

### **6.3.5.3 Effect 29: conflict**

The existence of "*Conflict*" in the R&D context was acknowledged at various levels in this study. It existed

*"everywhere because we are humans". (Interviewee, 13)*

"*Conflict*" was experienced in a multi-cultural environment such as the one of SQU. It often took place in the form of "*Boss vs. Subordinate*" where the role of the boss allowed him/her to redistributes workloads and re-set priorities in favour of some and to the disadvantage of others. An example: a HoD stopped an active researcher from conducting research that was relevant to the institution and the country.

*"Here {in SQU} I think it even worse because of different nationalities... I would not be surprised if certain ethnic group blocks someone from doing specific thing in terms of research... I think it happens that someone from one ethnic group supports someone else from the same group to do research... it certainly does affect the selection process. A colleague who has left now was stopped by the HoD for a number of years from doing research... his interests were appropriate to Oman and he is an outstanding researcher... SQU lost that opportunity because of these two individuals came from two countries that have long history of wars". (Interviewee, 13)*

Animosity could develop between two colleagues because one had his project approved. The other had a personal relationship with the HoD. The latter, with his authority to redistribute workloads, assigned more teaching load to the researcher in order to make him fail.

*“When I proposed my project... another project was proposed at the same time; mine was approved by the administration of the university and the other was not. It seems that that group wanted me to fail in my project because they are of the same nationality supported by other nationalities as well. So these differences help cause problems in every department I would say”. (Interviewee, 05)*

“Conflict” also occurred during setting research priorities at administration level. The decision on certain research themes meant that other department could be blocked from access to internal research funds. To overcome this “Conflict” the decision was taken to go for a wish list rather than proper research themes for the university. Such a wish list did not help to optimise research resources and to deliver successful research.

*“The committee worked well on most of the issues but when it came to setting the research theme it lacked leadership, it made up a wish list of themes for all departments”. (Interviewee, 03)*

In committees, “Conflict” was also common to the extent that one of the candidates was able to predict it before it happened.

*“I chaired such committee for four years, and I could see and I can even predict what will be the problems when I go in with that particular project.” (Interviewee, 12)*

Ineffective “Conflict” management jeopardised research success. R&D literature has ignored this effect hence this finding is newly derived in this study.

The effect “Conflict” was indicated in 7 out of the 40 (17.5%) extracts in the category “**Behavioural effects**” (Table 6.6). All groups of interviewees identified

this effects which reflects its importance to deliver successful academic research at SQU.

#### **6.3.5.4 Effect 30: politics**

To overcome conflicts in resource allocation for R&D projects political behaviour was emphasised. Some candidates used their political skills to succeed while others complained that political behaviour caused them to fail. For example, those who had negative experience such as being omitted from, or less favoured in the allocation of resources complained that other groups purposely working against them.

*“It seems that group wanted me to fail in my project”.  
(Interview, 05)*

*“A good researcher has gone down and a not so good researcher has been recommended because he has political clothes, if I may say so”. (Interviewee, 04)*

One of the successful researchers indicated that he used his political skills to ensure more resources for himself and his department.

*“I’m very influential at the college and very aggressive to get my department’s projects approved”. (Interviewee, 06)*

The same candidate argued that this political approach was common. Network power enabled some researchers to enjoy the influence of personal contacts from within or without SQU. Projects that were of no strategic importance were approved based on personal relationships. An example was a project that

*“was funded because someone knew someone else. The money was given because of the relationship of two people. (Interviewee, 06)*

Some political behaviour raised ethical concerns. It was very common to find that researchers attempted to buy off their leaders in order to get the desired support.

*“When I first came I submitted a proposal and my HoD told me to put his name on it and promised to work with me but he did not. For the next one I did not put him on and when he asked me to do that I told him that you did not work with me on the first one. You know what happened next, I became his first enemy in SQU, then I mentioned that to one of my colleague he told me that all others are putting his name otherwise they will not get his support. I had to put his name and go to him apologized and told him that he did actually review the work from time to time and that is a kind of participation in the project then he accepted. If I did not do that he will not support me and I would have been failed”. (Interviewee, 07)*

*“You see the name of the HoD on every published paper I call that politics and bad one. You see the dean’s name on many research proposals when he is not doing anything apart from putting his signature on the proposal. (Interviewee, 06)*

*“Our HoD name is on every single research project proposal submitted, you know why because without that no support is going to be given to that project from the department, nowadays I see some proposals with the assistant dean name of course that is for more support by the college”. (Interviewee, 22)*

*“This is life that we are in and we have to navigate. I personally have the HoD name in all my projects and he does not contribute to the project except with the support that I should be given anyway like everyone else”. (Interviewee, 22)*

Despite the committee structure, decisions in committees were frequently taken by their chairmen. Decisions were politically manipulated towards some R&D projects. Researcher realised the importance of “Politics” to get resources for their projects. For example, although a committee structure exists in SQU, projects were rejected because influential members had other priorities.

*“It was rejected, because the members want, one very influential person from the committee... Because of that person he was more influential at that time; fortunately he*

*is no more here. Sometimes some people would monopolize the committee and that decision is like veto". (Interviewee, 17)*

*"We have committees in the department, the college and even in the university but the decisions in these committees are dictated by the chairman of the committee who is in most cases, the HoD, the Assistant Dean, the dean or DVC". (Interviewee, 22)*

*"Because who decides and who gets what?... Before the committee, they decide, they have the set of to whom to decide. This is very important; there is no objective criterion of scaling down the research budget". (Interviewee, 18)*

Committees' members who knew that their views would be not considered politically kept a low profile. On many occasions members did not support the chairman's decision but they submitted to it because he was more senior. They wanted to be in his side as a bargaining strategy in order to ensure his support for other decisions.

*"The chairman will end the discussion and nobody wants to challenge him...They did not want to challenge him because he is a professor and more senior he is a dean you see, out of 9 deans in the university he is the most senior one". (Interviewee, 03)*

"Politics" enabled researchers to overcome "Conflicts" and increased the chances of success. R&D literature has ignored this effect hence this finding is newly derived in this study.

The effect "Politics" was indicated in 8 out of the 40 (20%) extracts in the category "**Behavioural effects**" (Table 6.6). This effect was common among all groups of interviewees, which reflects the perceived importance of this effect for R&D success.



### 6.3.5.5 Summary of category five - theme 12

The thematic analysis of 40 extracts from the interviews in this study revealed four effects; “*Motivation*”, “*Organisational leadership*”, “*Conflict*” and “*Politics*”. These effects were grouped in the category “**Behavioural effects**”.

Organisational and individual behaviour influenced the performance of SQU R&D. Researchers needed intrinsic “*Motivation*” from the nature of work they executed and also extrinsic “*Motivation*” from their organisation. “*Motivation*” through incentives increased the chances of success of R&D projects. Effective leadership removed obstacles from the R&D process. “*Conflict*” of interest was a natural phenomenon that jeopardised research success. “*Politics*” enabled some researchers to overcome “*Conflict*” and increased the chances of success. R&D literature has ignored most of these effects. The wide identification of “**Behavioural effects**” reflects the importance of these effects to research performance.

## 6.4 DISTRIBUTION ANALYSIS

In this section, distribution of effects by interviewees is presented; this includes nature of science, rank of interviewee and administration experience of the interviewees.

### 6.4.1 Distribution of extracts and effects on Interviewees based on science classification of the interviewees

BS contribution was 80 (28.0%) extracts with an average of 2.7 extracts per effect and the number of extracts per interview ranged from 8 to 21. The average of extracts per BS interviewee was 11.4. AS researchers recorded 124 (43.4%) extracts with an average of 4.1 extracts per effect and from 9 to 19 (average of 13.8) extracts per interview. Candidates from SS contributed 82 (28.7%) extracts with an average of 2.7 extracts per effect and from 8 to 18 (average of 13.7) extracts per interview, see Table 6.8. These findings suggests

that the researchers of AS had been exposed more to effects of the implementation of R&D at SQU and/or were more prepared to talk about their experiences and opinions, as compared to their colleagues in BS and SS.

<b>Nature of science</b>	<b>Number of Interviewees</b>	<b>No. of extracts</b>	<b>% of extracts out of 286</b>	<b>Average extracts per effect</b>	<b>Average extracts per interview</b>	<b>Range of extracts per interview</b>
<b>BS</b>	7	80	28.0	2.7	11.4	8 - 21
<b>AS</b>	9	124	43.4	4.1	13.8	9 - 19
<b>SS</b>	6	82	28.7	2.7	13.7	8 - 18

Table 6.7: Distribution of extracts on based on their nature of interviewees' science classification.

#### **6.4.2 Distribution of extracts and effects on interviewees based on their rank**

FPs provided 122 (42.7%) extracts with an average of 4.1 extracts per effect. Their contributions averaged 15.3 extracts per interview and ranged from 9 to 19 extracts per interview. MPs scored 87 (30.4%) extracts with an average of 2.9 extracts per effect. MPs contributions averaged 10.9 extracts per interview and ranged from 8 to 21 extracts per interview. APs contributed 77 (26.9%) extracts with an average of 2.6 extracts per effect. Their contributions averaged 12.8 extracts per interview and ranged from 8 to 18 extracts per interview.

<b>Researcher rank</b>	<b>Number of Interviewees</b>	<b>No. of extracts</b>	<b>% extracts out of 286</b>	<b>Average extracts per effect</b>	<b>Average extracts per interview</b>	<b>Range of extracts per interview</b>
<b>FP</b>	8	122	42.7	4.1	15.3	8 - 21
<b>MP</b>	8	87	30.4	2.9	10.9	9 - 19
<b>AP</b>	6	77	26.9	2.6	12.8	8 - 18

Table 6.8: Distribution of extracts on interviewees based on their rank.

### 6.4.3 Distribution of extracts and effects on interviewees based on their administration experience

AE researchers contributed 193 (67.5%) statements with an average of 6.4 extracts per effect. Their contribution averaged 14.8 extracts per interview and ranged from 8 to 21 extracts per interview. LAE researchers recorded 93 (32.5%) extracts with an average of 3.1 extracts per effect. LAEs contributions averaged 10.3 extracts per interview and ranged from 9 to 17. These findings (Table 6.10) indicate a relationship between the AE and the appreciation of the wide variety of possible implementation effects.

Administration experience	Number of Interviewees	No. of extracts	% of extracts out of 286	Average extracts per effect	Average extracts per interview	Range of extracts
AE	13	193	67.5	6.4	14.8	8 - 21
LAE	9	93	32.5	3.1	10.3	9 - 17

Table 6.9: Distribution of extracts from interviewees based on their Administration Experiences.

### 6.4.4 Conclusion

The major contributions to the findings of implementation effects on R&D projects were made by the AS group, FP researchers and the AE category. These findings suggest that AS researchers experienced more effects due to implementation policy compared to their colleagues in BS and SS. The findings also suggest that career progression and/or exposure to AE, assisted academics to build experience of implementation effects on their research.

## 6.5 CHAPTER SUMMARY

In this chapter, the results of implementation effects were presented. A total of 30 effects were identified by the use of thematic analysis. They were categorised in five categories; “**Strategy related effects**”, “**Task/Project**

**related effects”, “Team related effects”, “Organisational effects” and “Behavioural effects”.**

National strategies and policies assisted SQU to draft research priorities in line with its strengths and weakness. Shared *“Understanding of business objectives and research mission”* directed assisted project success. Working to satisfy the expectation of funding bodies (public) had assisted in placing research projects in a position to succeed, in public terms. These effects were related to R&D strategy formation and implementation.

Successful project had clear objectives and were of a multidisciplinary nature. Pilot studies increased the probability of success of the bigger projects. Where end-users were involved their comments on project objectives were highly valued and increased the likelihood of success of projects. The more a project was appropriate to the institutional strategy, was feasible, and was cost effective and properly planned the more likely it was to succeed.

Teams with right composition, research profile and correct attitude on the part of the researchers tended to delivered successful projects. Skilful project leaders used project management skills to manage their team and reduced the risks of failures that were induced by heavy teaching and administrative workloads and communication problems. Successful teams obtained expert opinions and enhanced their awareness of intellectual property.

A culture of competition improved project quality; scientific discussions and cross-project collaboration enriched research projects and assisted in the overcoming of resource limitations. *“Management commitment and support”* provided R&D projects with the necessary resources and sufficient funding to succeed. *“Clear and flexible rules”* provided effective administration of research and supported it. The processes of evaluation and *“Monitoring”* ensured fulfilment of **“Project”** and **“Team”** related effects. The *“Availability of resources”, “Availability of infrastructures” and “Availability valid data”* provided smooth and successful R&D execution.

Organisational and individual behaviour influenced R&D performance. Incentives and penalties "*motivations*" supported effective leadership to help R&D teams. "*Politics*" enabled some researchers to overcome the natural phenomenon of "*Conflict*" and increased their chances of success.

Some of the implementation effects were identified by the R&D literature (see Cooper, 1993 and 2001; SPRU, 1972; Jawad, 1995; Brown and Eisenhardt, 1995; Balachandra and Friar, 1997; Ernst, 2002; Mallon, 2002; Pilbeam, 2002; Herzberg, 2006; Ottenbacher et al., 2006; Jimenez-Jimez, et al., 2008; Buganza et al., 2010; Henard and Dacin, 2010) and Higher Education literature (see Middlehurst and Kennie, 1995; Connell, 2004; Middlehurst, 2004; Hazelkorn, 2005). The culture of internal scientific discussion and collaboration (i.e. between projects) with the same institution is newly identified here. The effects of reinforcement "*Motivations*", "*Conflict*" of interest and "*Politics*" on research performance are newly derived by this study.

The technique of distribution analysis showed that AS researchers experienced more implementation effects as compared to their colleagues in BS and SS. Career progression and/or AE exposure assisted academics to experience more implementation effects.

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## 7 DISCUSSION

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### 7.1 INTRODUCTION

The previous two chapters presented the findings of the study. In this chapter, these findings are discussed. Twelve themes have emerged from the data analysis; seven success measure and five implementation effects. The measures of success are “**Standard measures of project success**”, “**Knowledge production**”, “**Educational contributions**”, “**Capacity building**”, “**Institutional economic benefits**”, “**Policy benefits**” and “**Broader social benefits**”. The implementation effects are “**Strategy related effects**”, “**Task/Project related effects**”, “**Team related effects**”, “**Organisational effects**” and “**Behavioural effects**”. Emergent themes and sub-themes are related to previous literature and elaborated with a series of propositions.

The relationship between emergent themes is shown schematically in Figure 7.1. The research question is “***How does R&D implementation influence the performance of publicly funded research in SQU?***”. Implementation effects integrate themselves dynamically and influence success measures. Produced knowledge and enhanced R&D capacity enable further research work through use of knowledge and facilities. This complex dynamism (of both effects and measures) suggests that implementation effects are influenced by their context.

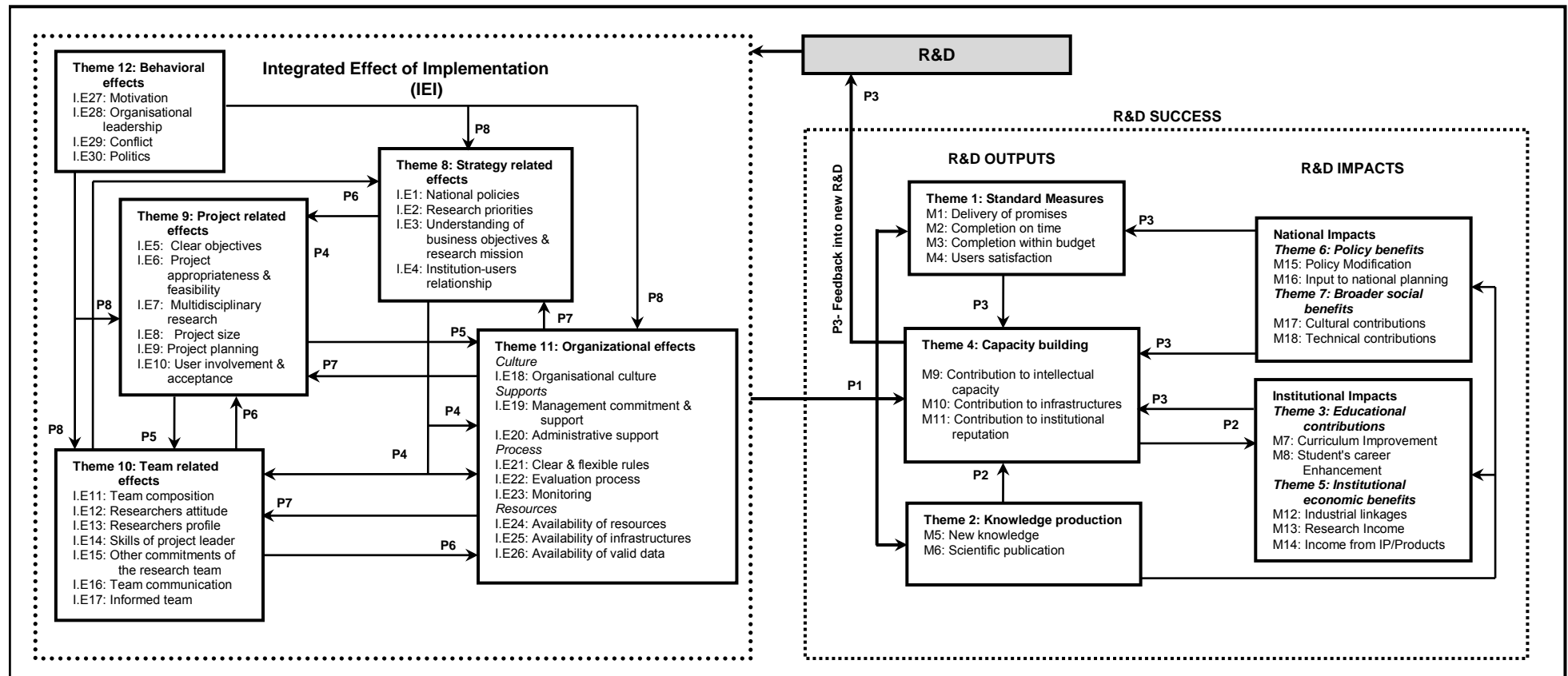


Figure 7.1: Implementation effects integration (IEI) and their influence on the performance of R&D project.



## 7.2 SUCCESS OF ACADEMIC RESEARCH

The findings of this study show that R&D success has direct results “**Outputs**” and indirect ones “**Impacts**”. Outputs are direct results in terms of scientific merit; educational outputs and technological results. They take the form of “**Knowledge production**”, “**Capacity building**” and/or “**Standard measures of success**”. Although the direct outputs of R&D are measures of success by themselves, they have consequent, institutional and national, “**Impacts**”. Impacts are application of new knowledge including the impact on the scientific community, on educational provision and on socio-economic needs. They are forms of “**Educational contributions**”, “**Institutional economic benefits**”, “**Policy benefits**” and “**Broader social benefits**”.

This section discusses R&D outputs and impacts. It is structured in a way to reflect emergent themes from this study. First, each category of success measure is discussed in isolation from other categories. Then links between these measures are discussed and elaborated with some example from R&D literature and/or from this study.

### 7.2.1 R&D Output

#### 7.2.1.1 Standard measures of project success

The first set of measures provides standard criteria to measure performance of research. In SQU researchers addressed the fulfilment of research contract conditions from a project management stand point. One of the participants acknowledged

*“One of the indicators for success is to finish what you promised to do on time and at the agreed cost”.  
(Interviewee, 22)*

This finding informs the previous works of R&D literature. Successful R&D delivers its promises (Pilbeam, 2002) within approved timeframes and budgets (Jawad, 1995; Mallon, 2002) and satisfies their end-users (Pinto and Slevin,

1987; Balachandra and Friar, 1997; Jawad, 1995; Mallon, 2002; Goffin and Mitchell, 2005; Ottenbacher et al., 2006).

### 7.2.1.2 Knowledge production

The second set of measures is related to knowledge discovery and dissemination. In SQU, successful R&D has developed new knowledge and served to solve some natural puzzles and describe previously mysterious phenomena. The findings of these projects were published through scientific outlets. This finding supports the HERG payback model and the literature of Higher Education. Successful R&D can establish a new research method, or enhances the understanding of an existing one, it discovers “*New knowledge*” or confirms/refines existing ideas (Buxton and Hanney, 1994; Hanney et al., 2004). These findings also support Higher Education literature. Research deliveries are disseminated in the form of “*Scientific publication*” through journal publications, conference papers and speeches in symposiums (Buxton and Hanney, 1994; Arnold and Balázs, 1998; Geuna and Martin, 2003; Hanney et al., 2004).

### 7.2.1.3 Capacity building

The third set of R&D output measures is concerned with building intellectual, infrastructural and reputational R&D capacity. Participants assumed this measure as an objective of their research projects. One of them emphasised

*“We are building on our strength”. (Interviewee, 06)*

This finding is in line with the conclusions in the literature. Successful R&D contributes to “**Capacity building**” through the development of research skills and analytical thinking (Buxton and Hanney, 1994; Hanney et al., 2004). Successful research opens a new research window or highlights priorities for further research. Such intellectual capacity is essential to survive in a competitive R&D environment. Contributions to the institutional infrastructures and training of technicians to operate newly acquired machines add value to

R&D capacity (Jawad, 1995; Mallon, 2002). Newly established collaborations compensate for R&D intellectual and facilities shortages (Buxton and Hanney, 1994; Hanney et al., 2004).

Some of R&D projects in SQU organised conferences enhanced the reputation of SQU in scientific and industrial mediums. This supports the literature of Higher Education. Successful R&D organises events for knowledge dissemination (Arnold and Balázs, 1998; Geuna and Martin, 2003) and is recognised by prize awards (Connell, 2004). Such events enhance institutional reputation and contribute to R&D capacity.

## **7.2.2 Impacts of R&D**

The first level of success measures of R&D (i.e. the direct output) has some implications; some within the institution and others outside it. This supports Higher Education and R&D literature (see Buxton and Hanney, 1994; Arnold and Balázs, 1998; Geuna and Martin, 2003; Hanney et al., 2004). These impacts are discussed in the following sub-sections

### **7.2.2.1 Educational contributions**

In SQU, publicly funded R&D provided students with cutting edge information and access to newly acquired equipment. More focus was given on research topics which enabled better job offers for involved students. This finding is in line with Humboldt's concept of university research (Etzkowitz, 1989; Arnold and Balázs, 1998; Geuna and Martin, 2003). However, the use of these measures "*Curriculum improvement*" and "*Student's career Enhancement*" to indicate research "**Educational contributions**" is newly derived empirically.

### **7.2.2.2 Institutional economic benefits**

Successful research projects led to research income for SQU. New R&D activities in the forms of industrial collaborations, consultancies and contract

research increased. This findings support Higher Education literature. Some governments fund academic research with the intention of enabling universities to generate research income (Etzkowitz, 1998; Connell, 2004; Hazelkorn, 2005; Pilbeam, 2006 and 2008; HEFCE, 2009). For example, in 1999 the UK HEFCE introduced “**third stream**” funding specifically to support the Higher Education sector tuning its research to meet the needs of business and the wider community (HEFCE, 2009). In 2007 contract research income in UK universities was 32% of the total research income; collaborative research income was 23%, short courses 19% and consultancy contracts 11% (HEFCE, 2009).

SQU’s participants acknowledged the potential economic value of their inventions. Some projects obtained patents and copyrights to protect these potentials. This supports the literatures of R&D and Higher Education. Research projects generate income from IP and new product (Slaughter and Leslie, 1997; Varga, 1998; OECD, 1999 and 2000; Geuna and Martin, 2003; HEFCE, 2006 and 2009). In the UK for example, universities’ income from intellectual property related activities was 2% in 2007 (HEFCE, 2009) compared to 0.63% in 2005 (HEFCE, 2006).

### **7.2.2.3 Policy benefits**

One of the emergent impacts of academic research was “**Policy benefits**”. SQU’s successful research introduced changes and/or modification to national policies through “*Policy Modification*” and “*Input to national planning*”. For example, some researchers provided national planners with up-to-date information and informed decision-making processes. This is in agreement with the findings of HERG’s work. NHS R&D, for example, was used to delay or justify political decisions (Buxton and Hanney, 1994; Hanney et al., 2004).

### **7.2.2.4 Broader social benefits**

Other impacts were related to social benefits from academic R&D. At SQU some projects were considered successful because they either solved social

problems or at least worked on them. For instance, the contribution to the society awareness of a problem and its magnitude was seen as a success.

*“We did not solve the diabetes problem but we created awareness in the society about the health problem, we developed a walking pathway for people to start changing their lifestyle and people started to walk and changed certain food habits”. (Interviewee, 06)*

This findings support HERG’s model and the R&D and Higher Education literature. Successful research enhances cultural awareness on issues of concern (Buxton and Hanney, 1994; Arnold and Balázs, 1998; Hanney et al., 2004). R&D provides technical contributions to improve product qualities and solves associated problems (Cooper, 2001; Goffin and Mitchell, 2005; Langford et al., 2006; Henard and Dacin, 2010).

### **7.2.3 Dynamism of R&D success**

Successful research projects deliver outputs in the form of “**Standard measures of project success**”, “**Knowledge production**” and R&D “**Capacity building**”. Successful R&D projects improve intellectual capacity through building research skills and tacit knowledge, reputational capacity through new collaborations (Buxton and Hanney, 1994; Hanney et al., 2004) and infrastructural capacity through newly acquired facilities.

R&D outputs have some institutional and national “**Impacts**”. New acquired knowledge and facilities provide “**Educational contributions**” through more problem-focused education (*Curriculum development*) and, as a result, better job offers for students (*Student’s career enhancement*). The problem-focused teaching resulted from the involvement of students in research.

*“I teach my students real life problems in the classrooms so research needs to reflect in our daily teaching because I do not believe that theoretical material will make any good in regards to their employment neither to the country”. (Interviewee, 22)*

Among SQU researchers it was believed that successful research projects provided opportunities for students. Research involved students had better employment offers in comparison to the local market conditions. For example a research student (who worked as a research assistant) was employed by an international company because he was involved in this research.

*“A Korean company ... seen my name in this field and approached me. They asked me to test my model at a site of their selection and now they employ my research assistant. They gave him a better offer than PDO, that is one of my project benefits”. (Interviewee, 05)*

Know-how and use of facilities assist institutional economic returns (Arnold and Balázs, 1998; Geuna and Martin, 2003; Pilbeam, 2006). Produced knowledge provides national planners with data, informs political decision making (Buxton and Hanney, 1994; Hanney et al., 2004), introduces cultural awareness (Buxton and Hanney, 1994; Arnold and Balázs, 1998; Hanney et al., 2004) and solves technical problems for society (Goffin and Mitchell, 2005; Langford et al., 2006; Henard and Dacin, 2010).

Institutional and national impacts influence user satisfaction. In this study, one of the participants indicated that satisfied users developed confidence in SQU. The believed that SQU has

*“the ability to solve problems”. (Interviewee, 17)*

This confidence built on SQU's reputation and as a result, institutional competitive advantage was enhanced. This put SQU in a better position to attract more research grants, contracts and/or consultancies. SQU was recognised as conducting outstanding research in certain fields. One of the participants acknowledged this because he and his team were invited to submit a research proposal. He referenced this invitation to the fact the they

*“are recognised to be working on common diseases”. (Interviewee, 06)*

“**Knowledge production**” and “**Capacity building**” are the dynamic categories of R&D success. Knowledge and new discoveries are all about R&D and science. Without them there would be no contributions to other categories of success.

*“Without a contribution to knowledge, research cannot have a subsequent payback” (Buxton and Hanney, 1994, pp 7)*

R&D capacity facilitates new R&D projects through intellectual capacity, infrastructural capacity and institutional reputation. This dynamic process of R&D success is summarised in (next).

#### **7.2.4 Conclusions and propositions**

Successful research projects deliver new knowledge and bring in new facilities within approved timeframe and budget (**Output**). As a result, users that are satisfied with produced knowledge become confident in the institution. Successful R&D improves research intellectual capacity and encourages new collaborations. Newly acquired facilities add to the institutional R&D infrastructural capacity.

Newly acquired knowledge and facilities inform teaching. Focused education enables better employment offers for research involved students. Knowledge and facilities assist economic returns through know-how and use of facilities. Newly produced knowledge provides national planners with data and informs political decision making. It may also introduce cultural awareness and solves technical problem in society.

Institutional and national impact influences user satisfaction. As a result, institutional reputation is raised through customer confidence.

Success of academic research seems to be dynamic process (Figure 7.2). R&D projects produce knowledge and enhance R&D capacity through research intellectual skills and new facilities. Produced knowledge (through know-how),

further builds R&D capacity. The readiness of the institution to handle R&D facilitates new projects through institutional reputation, intellectual capacity and new facilities. The above conclusions lead to the following propositions:

- P1:** *Successful R&D is completed within time and on-budget and produces knowledge, builds capacity and satisfies end-users (Output).*
- P2:** *The Outputs of academic research inform teaching, support institutional economic returns and/or benefit nations through use of state-of art equipment and know-how (Impacts).*
- P3:** *The Impacts of R&D (Institutional and national) influence (positively or negatively) organisational reputations which affect future R&D (consequent Impact).*

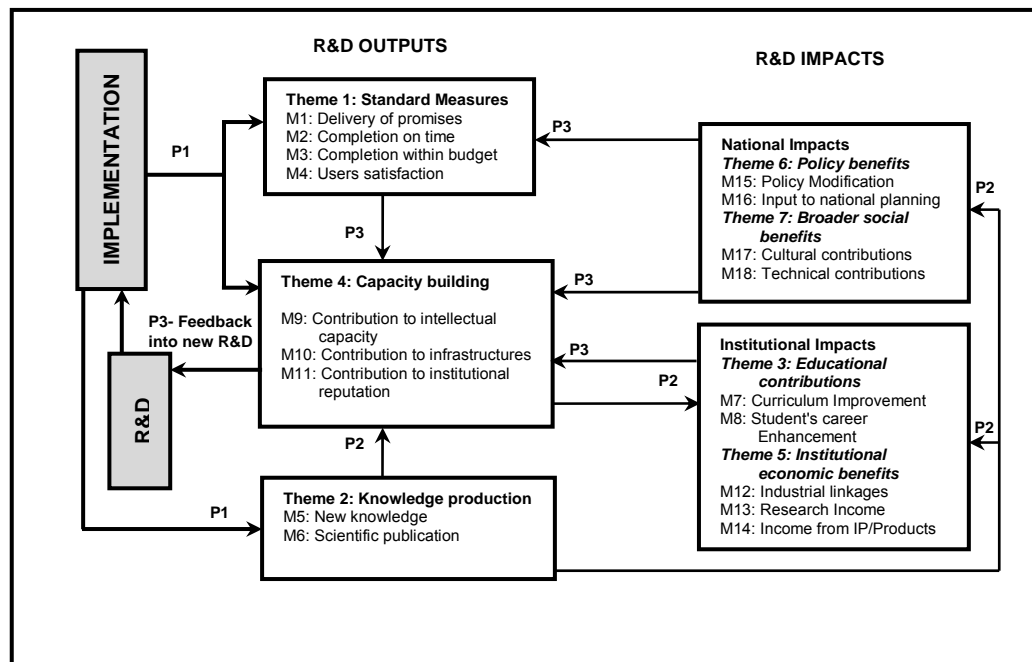


Figure 7.2 Dynamic success of academic R&D



## 7.3 EFFECT OF IMPLEMENTATION ON R&D PERFORMANCE

Five categories of implementation effects emerged from analysis of the gathered data. These are “**Strategy related effects**”, “**Task/Project related effects**”, “**Team related effects**”, “**Organisational effects**” and “**Behavioural effects**”.

This section discusses these effects on R&D performance. Similarly to the discussion of success measures, the structure of this section reflects emergent themes from this study. First, each category of implementation effects is discussed in isolation from other categories. Then links between these effects are discussed and elaborated with some examples from R&D literature and/or from this study.

### 7.3.1 Effects of R&D strategy

*“National policies”, “Institutional research priorities”, “Understanding of institutional business objectives and research mission” and “Institution-users relationship”* influenced the formation of SQU research strategy and affected R&D performance. Successful R&D projects were aligned to *“National policies”* and public interests. This finding is in line with the conclusions of previous work. For example, successful R&D projects are aligned to *“National policies”* (Carter, 1982; Etzkowitz, 2000; Nowotny, 2001; Pilbeam, 2002; Geuna and Martin, 2003) and public interests (Carter, 1982; Pilbeam, 2002).

In SQU, *“Research priorities”* reflected market demands and *“National policies”*. Successful research projects were guided by institutional *“Institutional research priorities”*. This confirms conclusions reported in the Higher Education literature. Universities develop research niches as responses to national policies and to ensure successful R&D (see Connell, 2004; Hazelkorn, 2005; Bushaway, 2003; Reichert, 2006; Pilbeam, 2008; HEFCE, 2009). Also, the literature of R&D indicated that market-oriented research is more successful than less market oriented (Cooper, 1981; Balachandra and Friar, 1997; Ottenbacher et al., 2006;

Herzberg, 2006; Jimenez-Jimez, et al., 2008; Buganza et al., 2010; Henard and Dacin, 2010).

SQU's researchers who understood institutional business objectives and research mission were more likely to deliver successful projects. Researchers emphasised that at the start of projects, most of them did not have a clear idea of how their research projects will be evaluated. If they were aware of SQU research evaluation requirements, they would have been more focused to satisfy the requirements and deliver successful outcomes.

*“People are not told what is expected from them, if they know what are the parameters that their research will be measured against they will be prepared to give an answer”. (Interviewee, 02)*

This finding supports R&D literature (see Souder, 1987; Jawad, 1995; Cooper, 2001 and 2005; Krishnan and Ulrich, 2001; Mallon, 2002; Pilbeam, 2002; Goffin and Mitchell, 2005; Ottenbacher et al., 2006; Johnson and Luo, 2008; Millson and Wilemon, 2008; Stendahl, 2009; Buganza et al., 2010; Henard and Dacin, 2010). For example, the researchers who understand company business objectives focus on projects that contribute to achieving company goals and strategically fit into overall firm's strategic areas (Cooper and Kleinschmidt; 1993; Cooper, 2001).

The nature of relationships (positive vs. negative) between SQU and end-users influenced R&D performance. This finding supports the literature of R&D (Maidique and Zirger, 1984; Balachandra and Friar, 1997; Cooper, 2001 and 2005; Krishnan and Ulrich, 2001; Ernst, 2002; Mallon, 2002; Goffin and Mitchell, 2005; Ottenbacher et al., 2006; Johnson and Luo, 2008; Johnson et al., 2009; Buganza et al., 2010; Henard and Dacin, 2010). For instance, good relationships with end-users contributed to the success of manufacturing technology acquisition (MTA) projects (Mallon, 2002).

### 7.3.2 Effects of R&D task/project

The initial idea and the end result of a R&D project influenced the project performance. This findings support the proposal that “*Clear objectives*” enable R&D teams and evaluators to see what the project intended to achieve and how (Souder, 1987; Balachandra and Friar, 1997; Cooper, 2001 and 2005; Krishnan and Ulrich, 2001; Goffin and Mitchell, 2005; Ottenbacher et al., 2006; Johnson and Luo, 2008; Buganza et al., 2010; Henard and Dacin, 2010). It also supports the idea that clearly defined research methods characterise successful projects (Pilbeam, 2002).

In SQU, the degree of project appropriateness was defined by “*National policies*” and institutional “*Research priorities*”, and project feasibility reflected the requirements needed to tackle the proposed idea. Successful project were appropriate and feasible. The findings here support that appropriate projects (to the institutional environment, country and market conditions) with feasible objectives succeed (see Cooper, 1990, 2001 and 2005; Balachandra and Friar, 1997; Krishnan and Ulrich, 2001; Goffin and Mitchell, 2005; Ottenbacher et al., 2006; Johnson and Luo, 2008; Buganza et al., 2010; Henard and Dacin, 2010). Further, when the R&D deliverables were high cost the project was considered a failure. This is similar to the failures of NPD projects because of high costs deliverables (see Rubenstein et al., 1976; Cooper, 1981; Pinto and Slevin, 1987; Balachandra and Friar, 1997).

The findings show that the multidisciplinary nature of R&D increased the chances of research success because it brought different backgrounds and experiences to the project. A participant argued that his project was successful because

*“The team {was} coming from different backgrounds”.*  
(Interviewee, 11)

This confirms R&D literature which emphasised on the positive influences of multidisciplinary and multi-functional objectives on R&D performance (Souder,

1987, Cooper, 1990, 2001 and 2005, Balachandra and Friar, 1997, Krishnan and Ulrich, 2001, Pilbeam, 2002, Goffin and Mitchell, 2005, and Ottenbacher et al., 2006, Johnson and Luo, 2008, Buganza et al., 2010; Henard and Dacin, 2010).

The smaller the R&D project the less the risks involved and the higher the probability of delivery of promises. In SQU, bigger projects required more resources and infrastructures that were difficult to resource. This problem was enhanced when the resource demands were not appreciated in the earliest stages of the project. This finding supports those reported in the R&D literature (see Jawad, 1995; Ernst, 2002; Mallon, 2002; Ottenbacher et al., 2006). For example, successful ITA projects are small in scope (Jawad, 1995).

Effective "*Project planning*" enabled SQU research teams to plan through the activities required well in advance. Researchers became conscious about achieving their objectives as required by the plan. They worked to ensure all resources were in place to achieve objectives on time. Rubenstein et al. (1976), Maidique and Zirger (1984), Souder (1987), Balachandra and Friar (1997), Cooper (2001) and Goffin and Mitchell (2005) indicated similar findings.

User's acceptance of the idea approved research concept for potential application of the findings at later stages. User's involvement during R&D implementation provided input to the SQU projects and bridges the team to the parties that apply the findings. Both effects contributed to successful performance. This finding supports the conclusions of the R&D literature. Involving end users, in idea generation, assist with determining their needs and requirements. It brings in knowledge about the user environments and enhances speed to market and product performance (Cooper, 1981, 2001 and 2005; Balachandra and Friar, 1997; Krishnan and Ulrich, 2001; Goffin and Mitchell, 2005; Ottenbacher et al., 2006; Johnson and Luo, 2008; Johnson et al., 2009; Buganza et al., 2010; Henard and Dacin, 2010).

### **7.3.3 Effects of R&D team**

The right composition of the research team brought to the project different skills and disciplines and enhanced its success. This finding confirms the R&D literature. Proper team composition facilitates functional co-ordination and assists in overcoming organizational interface challenges. It reduces implementation time and increases cost savings because problems are detected earlier in the implementation processes (Cooper, 1984 and 2001; Maidique and Zirger, 1984; Larson, 1988; Craig and Hart, 1992; Brown and Eisenhardt, 1995; Mallon, 2002; Goffin and Mitchell, 2005; Ottenbacher et al., 2006; Harmancioglu, 2007; Swink and Song, 2007; Stendahl, 2009).

In SQU, the defining attitude of a research team could enhance the chances of a successful R&D performance. This finding supports previous work in the R&D literature. For example, researchers' enthusiasm characterise successful research (Mallon, 2002; Pilbeam, 2002). Successful researchers showed ownership of their projects while those who failed tended to lack this feature (Pilbeam, 2002).

Successful R&D projects in SQU were properly resourced. Similar findings are indicated in the literature of R&D (see Jawad, 1995; Balachandra and Friar, 1997; Cooper, 2001; Mallon, 2002). Successful R&D has sufficient research time allocation, whilst failed projects do not. This finding informs the works of (Rubenstein et al., 1976; Carter, 1982; Jawad, 1995; Balachandra and Friar, 1997; Mallon, 2002; Pilbeam, 2002). Sufficiently allocated time interlinks with the responsibility of R&D teams for the entire project and is important to maintain their motivation and commitment (Cooper and Kleinschmidt, 1993; 1996; Ernst 2002; Goffin and Mitchell, 2005).

SQU's experienced researchers were able to handle technical and administration issues better than inexperienced teams. This finding is in line with the conclusions that technical and managerial skills are important for project success (Larson and Gobeli, 1989; Brown and Eisenhardt, 1995).

In this thesis, managerial and technical skills enabled project leaders to manage team members and organised them to deliver successful performance. This finding supports the R&D literature (Cooper, 1980; Maidique and Zirger, 1984; Cooper and Kleinschmidt, 1993, 1995 and 1996; Ernst, 2002). Managerial and technical skills, as well as the ability to delegate decision-making, are closely related to the effective leadership of a number of academics from different areas of expertise (Larson and Gobeli, 1989; Ernst, 2002; Brown and Eisenhardt, 1995). In SQU, effective communication skills (within the team and externally) enabled proper understanding and execution of R&D projects. R&D literature contains similar finding, that effective communication is a feature of successful R&D (Rothwell et al., 1974; Rubenstein et al., 1976; Allen, 1977; Souder and Chakrabarti, 1978; Booz et al., 1982; Souder, 1987; Craig and Hart, 1992; Balachandra et al., 1996; Balachandra and Friar, 1997; Ernst 2002; Pilbeam, 2002; Goffin and Mitchell, 2005).

The involvement of experts in the field brought their skills and expertise to SQU research projects. These informed the R&D team and enhanced the chances of success. In similar vein, Jawad (1995) argued that the use of consultants improves the success of ITA projects. The lack of awareness of the economic potential of the R&D results compromised the success of SQU's R&D. Similar findings were found in the R&D literature (see Carter, 1982; Mallon, 2002) and Higher Education literature (Etzkowitz 1989; Clark 1998; Etzkowitz et al., 1998 and 2000; Pilbeam, 2008).

### **7.3.4 Effects of the R&D organisation**

SQU, as organisation, influenced R&D through various routes. From the cultural perspective, lack of a competitive environment caused low quality research proposals. The works of Balachandra et al. (1996), Balachandra and Friar (1997) and Mallon (2002) indicate similar conclusions. The internal scientific discussions in SQU enriched the process of research and contributed to R&D success. While previous R&D works have overlooked this effect it was experienced in SQU and is newly derived by this study. Cross-project

collaboration within SQU compensated for a project's shortfalls in terms of resources and ideas. Pilbeam (2002) emphasised the importance of collaboration for academic research. However, collaboration between projects within the same institution is newly identified here.

SQU influenced R&D through the allocation of support. Committed management advanced SQU's research through the organization and provided sufficient resources for it. This contradicts the findings of Cooper (1993 and 2001) that projects supported by top managers fail and succeed at almost the same frequency. However the findings of this study support other R&D works (see SPRU, 1972; Jawad, 1995; Brown and Eisenhardt, 1995; Balachandra and Friar, 1997; Ernst, 2002; Mallon, 2002; Pilbeam, 2002). Committed and involved senior management provided considerable guidance and directions for projects (Ernst, 2002).

Research Administrators in SQU provided administrative and commercial support, and enabled the smooth fulfilment of formalities. These findings are absent from the R&D literature, however works in Higher Education address the importance of these effects on academic research (Connell, 2004; Hazelkorn, 2005; Kirkland, 2005; Pilbeam, 2008). From a procedural point of view, clear and flexible rules assisted SQU's researchers to adapt to uncertainties as they arose. In ITA literature, flexible regulatory environment contributes to successful project (Jawad, 1995).

Pre-award reviews of SQU's proposals ensured quality research proposals. R&D literature has addressed project selection as a means to improve R&D performance (Griffin and Page, 1996; Cooper, 2001 and 2005; Goffin and Mitchell, 2005; Herzberg, 2006; Harmancioglu, 2007). The literature of Higher Education found similarly (Arnold and Balázs, 1998; Geuna and Martin, 2003; Abramo, 2008). Monitoring research progress contributed to timely and quality completion of project milestones, in SQU. This is in line with the findings in the R&D literature. Follow-up and close monitoring plays a positive role in successful R&D performance (Rothwell et al., 1974; Rubenstein et al., 1976;

Cooper, 1981; Pinto and Slevin, 1987; Merrifield, 1988; Jawad, 1995; Cooper 2001 and 2008; Mallon, 2002; Pilbeam, 2002; Harmancioglu, 2007).

The last influence of SQU's organisation on R&D performance was resource availability. This study supports the R&D literature that proper funding is important for R&D success (Jawad, 1995; Cooper, 2001; Ernst, 2002; Mallon, 2002; Pilbeam, 2002; Ottenbacher et al., 2006). The findings also confirm that the availability of proper human resources contribute to R&D success (Mallon, 2002; Pilbeam, 2002; Ottenbacher et al., 2006). Lack of a proper infrastructure jeopardised SQU's R&D success. Success in the state-of-the-art research needed state-of-the-art facilities. This is in line with previous work (see Jawad, 1995; Cooper 2001; Ernst, 2002; Mallon, 2002; Pilbeam, 2002; Connell, 2004; Hazelkorn, 2005; Ottenbacher et al., 2006). Connell (2004) argued that although multidisciplinary research is at the focus of all universities the R&D facilities are discipline based which decreases the chances of successful performance by academic research. It is confirmed that lack of valid data creates a hole in R&D implementation systems, see the conclusions of Jawad (1995) where lack of valid data caused failure of ITA projects.

### **7.3.5 Effects of human behaviours on R&D performance**

The results show five effects of human behaviours on R&D performance. Incentives and penalties affect researchers' "*Motivation*", which is responsible for the effort and energy the researcher puts into his/her research (Kakabadse et al., 2004). To generate effort and energy individuals need stimulation by either their work, the post they hold and/or the people they work with. "Need Theories" address the drivers and/or stimulations that cause certain behaviour by individuals. People are usually motivated by the extent of good matching with their jobs. In the field of academic R&D, the extent to which the team finds the research project interesting motivates the researchers and contributes to successful performance (Pilbeam, 2002).



*“Motivation”* as an incentive, as an influential phenomenon, is addressed in the literature of R&D projects (Rowthwell et al., 1974; Ernst, 2002; Goffin and Mitchell, 2005; Ottenbacher et al., 2006). Successful innovators, for example, had more power, responsibilities, higher status and have delivered successful R&D as compared to unsuccessful ones (Rowthwell et al., 1974). Employees’ empowerment to take decision based on their judgement is also an incentive (Ottenbacher et al., 2006). The study in hand informs these findings. Monetary incentives, other than the pay packet, influence R&D performance. This is in line with organisational development literature (Kakabadse et al., 2004).

Reinforcement theories explain that people are motivated to perform well by incentives (positive reinforcement) for good performance. Conversely, ineffective behaviours should be punished (negative reinforcement) (Katzell and Thompson, 1990). Punishment of undesirable behavioural is supposed to reduce the occurrence of the unwanted behaviour. This study found that absence of punishment developed job security among researchers. This in turn de-motivated the successful ones in the long term. On the methods of reinforcement, human resources system could intervene and integrate researchers profile in their contracts renewals. This view is supported by Pfeffer (1994) and Bennett et al. (1998) and Ottenbacher et al. (2006). They indicated that the importance to link the human resources systems to the strategic decision making.

The study in hand found that performance of research was influenced to a great extent by the quality of the organisational leadership. Effective leaders created the necessary enthusiasm among R&D teams and boosted R&D performance. Some research projects succeeded because the HoD set an example himself for the rest of the academics in his department. Others failed because their leadership distanced itself from them and left the organisation to lead itself. These findings support the literature of organisational studies and Higher Education (Middlehurst and Kennie, 1995; Connell, 2004; Middlehurst, 2004).

Recent works have emphasised the role of academic leadership to navigate successfully between the command model “managerialism” and the complex

model “professionalism”. The need for a mixture of top-down and bottom-up decision making and a balance between soft and hard “managerialism” has been recognised (Middlehurst, 2004; Hazelkorn, 2005). Strategic initiatives cannot be successful without the active participation of individuals as key actors in the research process. This needs a leadership that

*“Commands the respect of the research community and is grounded in the intellectual values of that community is a more fitting model for contemporary university research management” (Connell, 2004, pp 32)*

The boundary between management and leadership is seldom clear as managers are generally leaders (Stewart, 1986). They practice social influence forms such as power and authority (Bryman, 1986). In universities, the situation is more complex as individuals (professionals) act independently and are self-managing (Middlehurst, 2004). In such an environment where the leadership function is attached to the same professional’s background as the staff, an effective leadership which recognise the appropriate actions for complex circumstances and continuously addresses constraints, contradictions and paradoxes is argued as most suitable (Handy, 1984). This appreciation is reflected in the balance between transactional and transformational activities (Kakabadse, 1999).

Middlehurst et al. (1992) studied the changing roles of senior university staff and identified three different functions of institutional leadership; educational, academic and administrative. The educational leadership contributes to broad policy debates on issues such as industry-university relationship, knowledge diffusion and other forms of entrepreneurial activities.

The academic leadership tackles issues related to the academic objectives and path of the institution such as discipline balance, academic activities (teaching and research) across the institution, human resources recruitments, new academic developments like inter-disciplinary research centres and science parks, academic collaborations, and curriculum modularisation.

Administrative leadership directs institution sustainability with focus on balance of diverse staff, activities and resources, (finance, plants and equipment). It also deals with motivational aspects such as the working environment, institution coherency, fund raising and external interpretation and external representation on behalf of institution. Administrative and educational leaderships are more apparent in the higher level of the institution while the academic one is more at departmental level. However institutional decision-makers act as “transactional” rather than “transformational” leaders (Middlehurst, 2004). Transactional leadership is about the skill and ability needed to lead day-to-day operations (Kakabadse et al., 2004). Such an approach, by itself, is inadequate for situations where urgent and sensitive changes are required. Transformational leadership creates a vision for the future and transform the organisation towards this vision (Kakabadse et al., 2004) which universities today, may be, in most need of.

The study in hand found that “*Conflict*” is a natural phenomenal influencing research performance. It exists at various levels at SQU. A participant experienced it

*“everywhere because we are humans”. (Interviewee, 13)*

R&D literature has ignored the effect of “*Conflict*” and hence this finding is newly derived. The literature of organisation studies addressed the effects of “*Conflict*” on business performance. “*Conflict*” is usually caused by differences between individuals’ (or stakeholder) personalities, cultures, values, goals, and interests (Pfeffer, 1981; Clark, 1988; Kakabadse et al., 2004). Differences, as natural things, cause conflict to arise as a natural phenomenon in a variety of shapes.

#### *Interrelationship-based conflicts*

Three factors contribute to the interpersonal conflict: interdependence, disagreement, and interference (Putnam and Poole, 1987; Thomas, 1992; Barki and Hartwick, 2001; Sutterfield et al., 2007). The first is a pre-condition of any conflict. It is a situation where the goals of a unit or individual depend, completely or partially, on the actions of another (Barki and Hartwick, 2001).

The second is the means to bring to the surface the interpersonal conflict. It reflects that the values, needs, interests, opinions, goals, or objectives of one person are not in line with those of another. The third is the behavioural feature of any conflict and refers to the situation in which an action by one impinges on the interests, objectives or goals of others.

### *Task-based conflicts*

In the case of academic research, task-based conflict deals with tension around which tasks or requirements should be carried out (Hearn and Anderson, 2002; Sutterfield et al., 2007).

### *Process-based conflict*

Conflicts about how to accomplish selected tasks are called process-based conflicts (Hearn and Anderson, 2002; Sutterfield et al., 2007).

### *Conflict in universities*

In universities and academic departments with their structures, functions, and relationships conflict is significant (Baldrige, 1971; Gmelch and Carroll, 1991). It divides departments and/or school boards. Positive and negative effects of conflict in academic departments are speculated about but there is little empirical evidence (Hearn and Anderson, 2002). Further, most of the literature of conflict in academic departments has the advancement of academics as the main focus and origin of conflict (Holton, 1995; Holton and Phillips, 1995).

Interpersonal differences in addition to differences in goals, programs, and practices are common origins of conflicts. Structural factors, instructional loads and differences in specializations and priorities promote conflict (Fox, 1992; Gumport, 1993). Individual and interpersonal conflicts can be linked to departmental tasks such as research verses teaching loads and/or processes of certain activity.

In the study in hand, conflict of "Boss vs. Subordinate" (Kakabadse et al., 2004) was experienced when the boss redistributed workloads and re-set priorities to

the advantage of some and the disadvantage of others, or approved one person's research bid and rejected that of another. Such situations can occur where one person in the conflict has personal links with the HoD. In extreme cases it has been claimed that a HoD assigned additional teaching load to a researcher so he would fail in his project.

Demographic, discipline, organizational and structural factors may add to the sum of conflicts on decisions of promotion and tenure (Hearn and Anderson, 2002). Demographic factors will include the size of the department and gender, nationality, seniority compositions within it. Gmelch and Carroll (1991) and Carroll and Harrison (1998) claim size is proportional to conflict, because as the size of a department increases so do the number of differences that can exist such as between two academics that came from two countries with a history of being at war.

*“These two individuals came from two countries that have long history of wars”. (Interviewee, 13)*

Politics enabled successful researchers in SQU to overcome conflicts. R&D literature has not reported this effect and hence this finding is newly derived in this study. The literature of organisation studies addressed “Politics” as the “unique domain” of interpersonal relations in the workplace (Vigoda, 2003) and an integral part of organizations (Kakabadse et al., 2004). Because of politics, people influence others (individuals and groups) to secure personal or collective interests or instead to block undesirable outcomes within the organization (Bozeman, et al., 1996). It comes to the surface in the form of struggles for resources, personal conflicts, competition for power, building personal stature, control access to information, not revealing real intents, and/or building coalitions. Politics, therefore, describes interpersonal behaviours and personal tactics of influence.

Because of these descriptions, politics is seen by some studies as a negative manipulation of other's opinions to achieve goals in improper ways (Vigoda, 2003). Political behaviour causes a stressful work environment where

performance of employees is evaluated unfairly, and employees develop negative attitudes about work (Drory, 1993; Ferris et al, 1996). Other works, however, viewed politics as a coin with two sides, one may harm the organization and the other may advance it (Kumar and Ghadially, 1989; Pfeffer, 1992). Harmful use of know-how, such as nuclear or genetic knowledge, does not justify blocking such knowledge. Recently Fedor et al. (2008) separated positive and negative organizational politics. They argued that positive and negative politics come from different and separate dimensions rather than two results of the same continuum. Positive politics are perceived in terms of positive reactions and negative politics are perceived in association with negative reactions. While some employees perceive organizational politics as an unfair, irrational and unhealthy behaviour those who want to get ahead and be promoted view it as a necessary skill (Voyers, 1994).

Other studies suggested that organizational politics is not only the essential skills to get things done but also has some meaningful and positive outcomes (Kakabadse et al., 2004; Bacharach, 2005). An organization's members may believe that political behaviour is necessary in order to advance (promotion) to be a good employee or talented manager (Gandz and Murray, 1980; Bacharach, 2005). Kakabadse et al (1982 and 2004) argued that politics in organisations is a normal phenomenon that occurs every day, and reported Lyman Porter's studies of promotion bids by management executives: successful executives attributed their success to their personal skills whereas unsuccessful executives attributed the failure to political behaviour, either being "out of favour" or less accepted as compared to others. Porter's findings are supported by this study. Some candidates attributed their successful R&D performance to their political skills while failed ones complained against such political behaviour as causing their failure.

Organizational politics are viewed in terms of conflict in organizations. Because conflict is a natural phenomenon in organizations and in order for managers to handle conflict in a proper way they need politics (Kakabadse et al., 2004). Politics is, therefore, perceived by some authors as a legitimate strategy in

response to situations of conflicts in the organization. For example, Whetton and Cameron (1991) argue that politics is personal ability to induce environmental changes with the aim of improving products. Putnam (1995) stresses that people who possess political influence use them to re-shape their environment and became satisfied and grateful. On the other hand, those who lack political influence remain unsatisfied and ungrateful. In this study it was found that politics enabled some researchers to enjoy the influence of personal contacts from within or from without SQU. Some SQU staff believed that R&D projects that did were not strategically important were approved based on personal relations. Decisions were politically manipulated towards some R&D projects. Researchers realised the importance of politics to get resources for their projects and believed that although a committee structure existed in SQU, projects were rejected because influential members had other priorities.

The existence of organizational politics cannot be prevented, and there will surely be those who will make evil and harmful use of it. Therefore, studies in management of innovation and R&D projects should attempt to define those conditions where the influence of organizational politics on various phases of the projects (strategy formation, project's appraisal and selection, team formation, resourcing, project execution, etc..) is negative, or, alternatively, positive. To do this one needs to learn the characteristics of good organizational politics so as to make intelligent use of it. Understanding organisational and individual differences is a mandate in effective utilisation of political actions for the benefit of the organisation (Kakabadse et al., 2004). Political behaviour in organisation is a

*“Means of bridging the gaps between the individual and their motivation (the needs of the person), the group they deal with and their norms and behaviour (shared attitudes of people), the general situations in which individuals find themselves and the accepted and unaccepted ways of people to interact with each other” (Kakabadse et al., 2004, pp 174).*

A way to bridge these gaps is to view politics as a process of influencing others' opinions to a certain view point (Kakabadse et al., 2004).

### 7.3.6 Contextualism of implementation effects

Previous R&D works emphasised the effect of identifying the right R&D projects and the effects of implementing them properly. Despite the formal process of selection and monitoring, only a few R&D projects had been successfully transferred into products and services (Griffin and Page, 1996; Cooper, 2001). To understand implementation in general, the literature of strategy and change implementation was reviewed and a conceptual framework (see chapter three) was developed. It consisted of four implementation approaches; classical and contingency (rational) approaches and behavioural and political irrational (or contextual) ones.

Rationalist approaches are identified with models of rational action where organizational change is conceived as a process that could be effectively planned and managed to achieve instrumental outcomes (Caldwell, 2005). Their positivist epistemology is characterized by a belief in humans as rational subjects or autonomous actors who can act in an intentional, predictable and responsible manner towards predetermined goals or planned outcomes. Contextualist interpretive approach, however, views knowledge and its applications as culturally and historically relative and situates them within the process of implementation (Foucault, 1992). Contextualism addresses the outer and inner contexts of strategy implementation (Pettigrew, 1987 and 1990) incorporated within a perspective that views "**Behavioural effects**" as endemic phenomenon (rather than disruptive one) in organizational life (Knights and Murray, 1994).

As indicated in chapter three, R&D models (linear and non linear) fail to consider the influences of irrational human behaviour such as faith, sentiment, will, mind-set and intuition. This is because they are rationalist approaches with positivist epistemology. This study with its interpretive epistemology brought



R&D implementation out of the existing “corner view” and spotted some potential answers to the shortcomings of R&D models.

SQU R&D strategy was influenced by its organisational structure and R&D capability. This is in line with the need for strategic analysis to understand organisation competencies (Goffin and Mitchell, 2005). This includes human and other R&D resources and infrastructures. R&D strategy, in SQU, directed idea generation towards strategic compliance and dictated resources forecasts and human strategies within the institution. This finding is in agreement with R&D and Higher Education literature. R&D strategy focuses research ideas to achieving company goals and strategically fit into the firm’s overall strategic areas (Cooper and Kleinschmidt, 1996; Cooper, 2001). Universities develop niches and strategic research areas. These areas are reflected in human resources strategies (Bushaway, 2003; Connell, 2004; Hazelkorn, 2005; Reichert, 2006).

R&D tasks and/or projects, in SQU, determined what kind of team composition and skills were required for the project. Diversity in backgrounds was essential for multidisciplinary research. In addition the right multi-backgrounds were needed to facilitate success of R&D projects. One of the participants highlighted that

*“you have to choose the correct team members”.*  
*(Interviewee, 09)*

Similarly certain R&D tasks/projects required certain organisational resources, such as facilities and data. When these requirements were not available in-house networks were involved. This is in line with the findings of Higher Education literature. Universities utilise networks to improve their research performance (Hazelkorn, 2005; Reichert, 2006).

R&D teams were linked with idea generation processes and were affected by the organisational R&D procedures and processes as well as by R&D strategy. In this study, participants acknowledged the need to hire the right researchers to respond to socioeconomic problems.

*“It is the university responsibility to find those new brains that could be used to solve national problems”. (Interviewee, 20)*

Administrative requirements such as accounting and finance affairs were an extra load for SQU academics. For example, the long time required to process a purchase small amounts hindered R&D teams in delivering successful projects. One of the participants said

*“The main problem that I faced was the procurement, it was not easy to procure even small things for the research”. (Interviewee, 07)*

In addition to technical and administrative effects, there are behavioural influences on R&D. These include leaders' behaviour, conflict and political skills within individuals. In SQU, “**Behavioural effects**” influenced strategy formation and implementation. For example, SQU had a wish list rather than proper research themes. This decision was taken to overcome “*Conflict*” over resources allocations. Such a wish list did not help to optimise research resources. A participant indicated that

*“The committee worked well on most of the issues but when it came to setting the research theme it lacked leadership, it made up a wish list of themes for all departments”. (Interviewee, 03)*

Informal organisations or interest groups (staff with common feelings, attitudes and values) influenced R&D performance, in SQU. For example, when conflict developed between two colleagues in the same department, over an application for research funding, one of the applicants and HoD belonged to the same interest group. The HoD assigned more teaching load to the other applicant to make him fail in his research project. This finding supports the literature of organisation development (Kakabadse et al., 2004).

These findings suggest an Integrated Effects of Implementation (**IEI**) of dynamic, iterative and non-linear nature (Figure 7.3). The **IEI** model confirms Pettigrew's theory of contextualism (Pettigrew, 1987). The procedural aspect of

R&D implementation is a continuing dynamic system, with a past, a present and a future (Pettigrew, 1985; Caldwell, 2005). Success of R&D project builds the capacity for future success. The multiplicities and integrations of internal and external effects are contextual (Caldwell, 2005). The central influence of politics and conflicts between the actors, within R&D implementation, over the direction and outcomes of R&D (Pettigrew, 2003) is contextual too. The unintended and unpredictable performance and the consequences of all rational actions, management planning and strategic decision making in R&D implementation confirm the contextualism of this process.

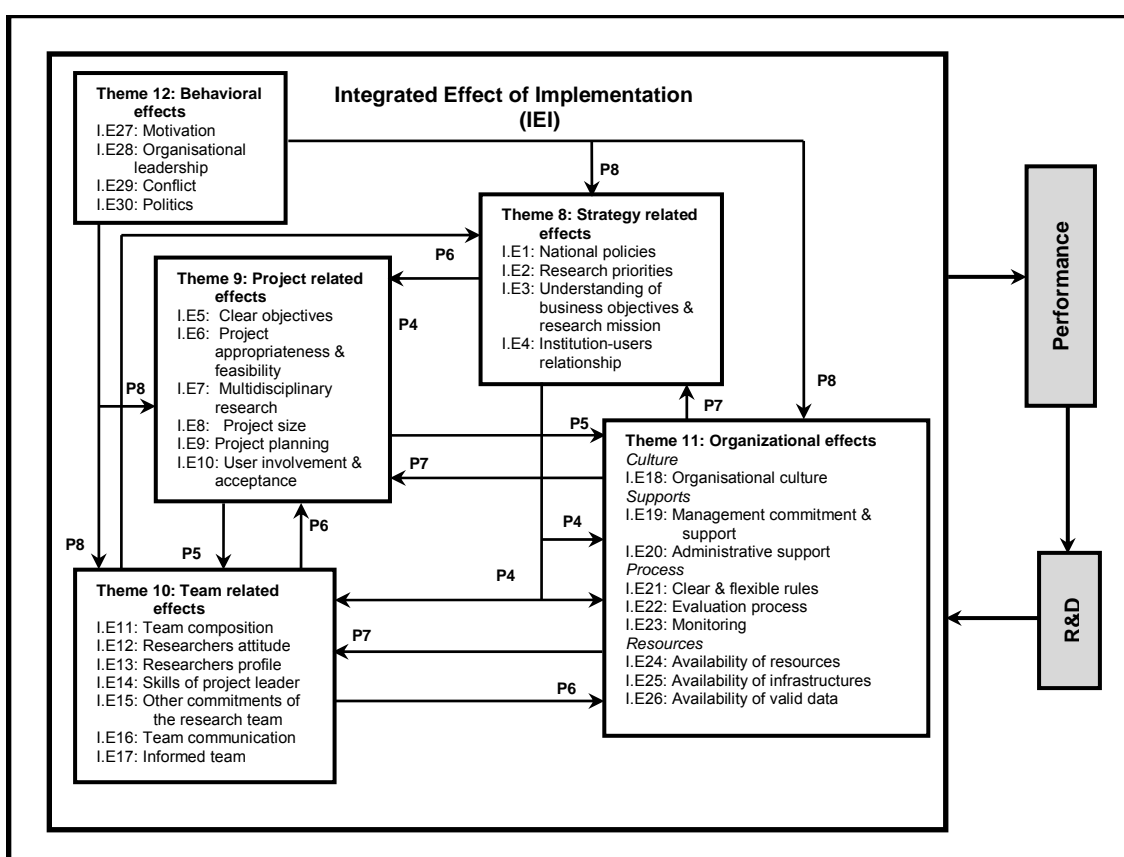


Figure 7.3: Integrated effects of implementation on R&D performance

### 7.3.7 Conclusions and propositions

The effects of R&D implementation integrate and influence R&D performance. Strategic management of R&D uses “National policies” to build research specialism according to the organisational strengths and weakness. Clear

understanding of business objectives and awareness of research mission direct the R&D team to short term and long term research objectives. Good relationships with end-users and public bodies are developed accordingly and research teams are encouraged to work to satisfy resource providers and user expectations. R&D strategy influences those ideas proposed for funding because successful applications have to comply with the strategic goals of the institution. The strategy also encourages researchers to satisfy end-users and drives the organisation to build good relationships with local authorities and end-users. These conclusions lead to the following proposition:

**P4:** *R&D strategy affects research performance through idea generation guidance, team formation and affects the processes of research evaluation and execution.*

Successful research has the characteristics of clear and multidisciplinary objectives that are developed, accepted and/or executed jointly by researchers and users. These objectives are appropriate to institutional strategy and feasible to achieve according to the organisation's R&D capability. Successful projects are properly planned and piloted before full launch and their end results are cost effective. Multidisciplinary research objectives demand the formation of a multidiscipline research team. Bigger teams need proper leadership and better skills. The objectives also influence the resource requirements as a larger number of objectives invariably need more resources than a smaller number. When the required resources are not available the organisation has to introduce other means such as cross-project collaboration to improve the situation. These conclusions lead to the following proposition:

**P5:** *R&D tasks influence project performance through team composition and other resources requirements.*

The most successful individuals in R&D have positive attitudes and a rich research profile. They possess a decent awareness of legal issues and use experts to compensate for any shortfall in experience. Successful R&D projects have integrated and multidiscipline teams which are not committed to other

tasks, have effective communication and a leader with project management skills. Effective R&D teams increase the organisational capacity to handle the research project. The processes of successful R&D strategy formation and execution are fine-tuned according to the characteristics of the research team. In many cases, research objectives are also derived from team characteristics especially in an academic environment where research ideas are proposed by academics. These conclusions lead to the following proposition:

**P6:** *R&D teams influence project performance through strategy formation, institutional R&D capacity, idea generation and execution of R&D project.*

Effective technical and administrative capacity of R&D organisations leads to successful R&D performance. Organisational strengths and weakness influence the formation of R&D strategy. A competitive environment and thoroughly evaluated proposals reduce the chances of low quality ideas. Availability of human resources, infrastructures and access to facilities and valid data provide smooth and successful R&D execution. Approved proposals are sufficiently funded and provided with the necessary requirements. These projects are administrated and monitored with the use of clear and flexible regulations. To overcome any resources limitations, the culture of internal scientific discussions and cross-project collaboration is facilitated. Committed management supports R&D projects with necessary requirements. The following proposition is derived as a result of these conclusions:

**P7:** *Organisations influence R&D performance through formation of R&D strategy, R&D team building and the idea generation and execution of the R&D project.*

Organisational leaders set an example for others. They use extrinsic (organisational) and intrinsic (from the nature of work) incentives and penalties to motivate R&D teams. Conflict is a natural phenomenon and when not properly managed it causes R&D failures. Political behaviour enables researchers to overcome conflicts and contribute to R&D success.

Organisational behaviour influences the formation of R&D strategy through conflict and politics, which affect the process of development of R&D ideas, especially where leaders bring to their units the spirit of research. This also motivates other academics and directs their research efforts. Resource allocation and other forms of decision making in the organisation are also affected by the individual's behaviours. The following proposition is derived as a result of these conclusions:

**P8:**            *Organisational behaviour influences R&D performance through decision making, formation and execution of R&D strategy and resource allocation for R&D projects including human resources.*

## **7.4 CHAPTER SUMMARY**

This chapter has discussed the findings of this study and placed them in the existing body of literature. Twelve themes have emerged from the data analysis. A list of proposition has been concluded and a model was proposed to answer the research question. Produced knowledge assisted R&D capacity through know-how and intellectual skills. Also, customer confidence and institutional reputation influenced R&D capacity (Ottenbacher et al., 2006). R&D capacity facilitated new R&D projects through institutional reputation, intellectual skills and new facilities.

The contextual influence of politics and conflicts over the direction and outcomes of R&D and the unintended and unpredictable performance of all rational actions, management planning and strategic decision cause R&D implementation to affect R&D performance in an integrated, dynamic manner. The findings here suggest contextualist (non rationalist) implementation effects on R&D performance.

Next chapter concludes the study and puts forward some recommendations for future research. It also draws on the limitations of this study.

## 8 CONCLUSIONS

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### 8.1 INTRODUCTION

This research explored how success of academic research is viewed by key researchers at SQU and how implementation of R&D policy affects R&D performance. A realist approach was undertaken to identify any underlying mechanisms of these phenomena and the way in which they manifest themselves. Drawing on a research gap identified in the literature, the main research question was;

*“How does R&D implementation influence the performance of publicly funded research in SQU?”*

The study involved semi-structured interviews with 22 academics in SQU. The analysis of 1,210 minutes of audio data uncovered 18 measures of success and 30 effects of implementation. In this chapter a summary of the key findings are presented together with details of the research contributions to theory, method and practice. The chapter also presents the limitations of the research and suggests topics for future research.

### 8.2 SUMMARY OF KEY FINDINGS

The study found twelve themes; seven success measure and five implementation effects. The measures of success are **“Standard measures of project success”**, **“Knowledge production”**, **“Educational contributions teaching”**, **“Capacity building”**, **“Institutional economic benefits”**, **“Policy benefits”** and **“Broader social benefits”**. The implementation effects are **“Strategy related effects”**, **“Task/Project related effects”**, **“Team related effects”**, **“Organisational effects”** and **“Behavioural effects”**. Most of these findings were in line with findings reported in R&D and Higher Education

literatures. A number, however, were newly derived here. In this section these findings are summarised.

### 8.2.1 Dynamic success of R&D

Successful research projects deliver new knowledge and bring in new facilities within approved timeframe and budget. The study in hand confirms the literature reviewed on this conclusion, see Section 7.2. Successful R&D improves research intellectual skills and critical thinking and encourages new collaborations. Newly acquired facilities add to the institutional R&D infrastructure capacity.

These outputs create “**Impacts**” at institutional and national levels. New knowledge and facilities inform the process of education. Focused curriculum enables better employment prospects for research involved students. Knowledge and facilities assist economic returns through know-how and use of facilities. Newly produced knowledge provides national planners with data and informs political decision-making. It may also introduce cultural awareness and solve technical problem in the society. As a result it improves social life conditions at large. Users satisfied with produced knowledge become more confident in the institution. This confidence builds an institutional reputation and as a result, the institutional competitive advantage is enhanced. This puts R&D teams in a better position to attract more research grants, contracts and/or consultancies.

“**Knowledge production**” and “**Capacity building**” are the dynamic categories of R&D success. Without knowledge and new discoveries there would be no contributions to other categories of success (Buxton and Hanney, 1994; Hanney et al., 2004). Produced knowledge assists R&D capacity through know-how. R&D capacity facilitates new R&D projects through institutional reputation, intellectual skills and new facilities.



### **8.2.2 Integrated effect of implementation**

*“National policies”* assists institutions to build research niches and strategies according to their strengths and weakness. Clear understanding of the research mission directs idea generation for R&D as well as R&D teams. Good relationships with end-users and public bodies encourage R&D teams to work to satisfy funders and end-user expectations.

Successful R&D has multidisciplinary objectives (accepted and/or executed jointly by researchers and end-users). These objectives are appropriate to institutional strategy and feasible to achieve within the organisation’s R&D capability and environment of operation. Based on proper plans and pilot studies, R&D success needs sufficient resources.

Research team requires proper leadership and skills. Effective project leadership informs the team members with the use of experts and internal cross-project collaborations. Researchers’ positive attitude, rich research profile and effective communication succeed when they are not committed to other tasks. R&D strategy is fine-tuned according to the characteristics of organisation intellectual capacity. Many times research objectives are also derived from team characteristics especially in an academic environment where research ideas are mostly proposed by academics.

Organisational strengths and weakness influence the formation of R&D strategy. The culture of competition and thoroughly evaluated proposals reduce the chances of low quality ideas being funded for research. Availability of resources, infrastructures and valid data provide smooth and successful R&D execution. Approved proposals need to be adequately funded and resourced. Successful projects are administrated and monitored using clear and flexible regulations and supported by a committed management.

Organisational leaders set example for others and use extrinsic and intrinsic motivations. Conflict is a natural phenomenon and when not properly managed it causes R&D failures. Political behaviour enables researchers to overcome

conflicts and contributes to R&D success. Organisational behaviour influences the formation of R&D strategy through conflict and political manoeuvring. Leaders affect the process of R&D idea, especially where they bring to their units the spirit of research. Resources allocation and other forms of decision making processes in the organisation are also affected by the individual's behaviour.

The dynamic nature of R&D means that every successful R&D project builds the capacity for future success. The integration of internal and external effects is contextual. The central influence of politics and conflicts between the R&D actors over the direction and outcomes of R&D is contextual too. The unintended and unpredictable consequences of irrational actions taken as part of management planning and strategic decision-making in R&D implementation confirm the contextualism of R&D implementation.

### **8.3 CONTRIBUTIONS OF THE STUDY**

Research contributions are made through four strategies of conceptual development (Easterby-Smith et al., 2004). The firstly contribution is to connect new concepts to an ongoing debate in the research field. The second is to integrate streams of work and ideas within the same field which previously were separated. The third introduces concepts from another field outside the main area of research. And the fourth is to develop concepts from "blue sky" thinking. The findings of this research validate, extend and challenge previous research into R&D management. The findings also add new theoretical insights into how R&D success is perceived and managed from researchers' perspective. In doing so this research makes a contribution through all four of the Easterby-Smith et al., (2004) strategies.

#### **8.3.1 Contributions to theory**

The general contributions of this research to theoretical knowledge enhance our understanding of what R&D success is, the effects of implementation on R&D

performance, extending strategy implementation literature to R&D management. By providing empirical evidence of the effect of implementation on R&D performance, this study also makes a number of more specific contributions to the literature of R&D. These contributions to academic knowledge are discussed below and broadly include:

- Introduction of dynamic success of R&D.
- Introduction of rational and irrational (contextual) effects to implementation of R&D.
- Confirming the importance of contextual limits in considering R&D success.
- Presenting a holistic picture of R&D implementation that integrates different effects on performance identified in the literature.
- The study supports the literature of organisational change on the contextualist nature of organisational change.

#### **8.3.1.1 Success of academic R&D**

This study adds to the theory of R&D success. It validates and builds on Arnold and Balázs (1998) definition of R&D “**Output**”. These are the direct results of the research in terms of scientific results. The study introduces project management criteria for successful performance in R&D. “**Standard measures of project success**” are derived empirically. These include objective achievement within time and budgets and customer satisfaction. The study finds success of R&D in the form of contributions to institutional R&D capacity such as new collaborations and equipment.

The study in hand also adds to the concepts of “**Outcome**” and “**Impacts**” of Arnold and Balázs (1998). R&D outcomes, as seen by Arnold and Balázs (1998), are internal changes and benefits that result from the outputs. This study extends this. “**Institutional economic benefits**” use knowledge to generate research income for the institution as well as the potential “**Educational contributions**” through “*Curriculum improvement*” and “*Student*

*career enhancement*". Impacts in Arnold and Balázs (1998) are the effect of outputs and outcomes on the broader environment. This includes the impacts on the scientific community, the non-research effects on educational provision and on social and economic needs. In the study in hand, the measures of "**Broader social benefits**" and the "**Policy benefits**" validate Arnold and Balázs (1998) claims and provide insights into what indicators could be used to view such impacts.

The study clarifies the dynamic nature of R&D success. It shows that "**Knowledge production**" and "**Capacity building**" are dynamic elements in R&D success. "**Knowledge production**" and "**Capacity building**" improve the "know-how", encourage new collaborations and add facilities to the institutional R&D capacity. These outputs create opportunities for "**Institutional economic benefits**" and "**Educational contributions**". They also, provide national impacts through "**Broader social benefits**" and "**Policy benefits**". Satisfied users become more confident in the institution's capacity to deliver successful research. Institutional reputation puts the institution in a better position to attract more research grants, contracts and/or consultancies. These endeavours feedback into "**Knowledge production**" and "**Capacity building**" categories and the process continues.

### 8.3.1.2 Influences on R&D success

This study validates many previously found implementation effects on the success of R&D project. It adds to those effects identified in the literature. This interpretive study brought R&D implementation out of the existing "corner view". It has used the knowledge of strategy implementation and organisation development to understand R&D implementation and thus enhances the understanding of how implementation of R&D affects its performance. The integrated effect of implementation (IEI) provides a holistic picture of how these effects integrate in order to influence R&D performance. IEI influences R&D performance through technical and administrative capability of the R&D organisation as well as through the behaviour of the organisation's members.

These include leader behaviours, conflict and political skills within individuals. Behavioural effects of conflict and politics on R&D performance are empirically derived by this study.

The IEI model developed here contributes to R&D theory with the iterative, non-linear and processual nature of R&D implementation. R&D success builds up the capacity for future success and induces a contextual component. The integrations of internal and external effects are also context based. The central influence of politics and conflicts between the R&D actors is contextual too. This contextualism may explain why much R&D performance is still unintended and unpredictable despite all rational actions, management planning and strategic decision-making during implementation.

### **8.3.2 Contributions to methodology**

This research extends the use of qualitative research methods to a study of the implementation effects on R&D performance within the organisation from academics' perspective. The study uses an inductive/retroductive research strategy and grounded data analysis approach. In taking a realist exploratory approach, the researcher was able to analyse the researchers' accounts of actual implementation incidents and how they influenced R&D, as opposed to using the realist, qualitative, exploratory, grounded approach for theory testing. The inductive/retroductive strategy and the grounded data analysis approach allowed for theory to flow from the data and the research themes to be fully investigated.

Through the application of the interpretive coding procedure, this thesis also extends the interpretive, contextualist research methodology into an area dominated by positivist research methods, thus allowing theory to emerge from the researchers' real-life of implementation effects on R&D performance within the organisation.

### 8.3.3 Contributions to practice

This research provides a valuable contribution to the practice of R&D management. It draws attention to the behavioural dimensions in R&D implementation. Researchers have to handle a wide range of implementation effects within their organisations in order to meet their research objectives. Besides technical, technological and administrative effects, human behaviour can be a barrier in R&D implementation. This research demonstrates that an understanding of internal conflicts and how these conflicts are managed are essential skills of the research team. Participants highlighted some of the potential negative consequences of conflict, if not managed properly, within the organisation which could result in frustration, increased competitive behaviour and de-motivation. Thus, in practice it is vital that R&D teams are fully equipped with the necessary skills to fully carry out their duties which include the management of organisational and personal conflict.

Another element of value to R&D practice is the need to establish an effective leadership in R&D organisation. The IEI model pinpoints the main areas for sustained success. Knowledge is a source for other R&D outputs and impacts and R&D capacity enables other, future successes. R&D managers need to build this into their management approach and R&D performance systems. Further, R&D leaders need to keep an eye on the complexity of their R&D contextual circumstances knowing that current successes do not ensure future ones. They need to balance transactional and transformational activities (Kakabadse, 1999) to, continuously, lead R&D teams to success.

As discussed in chapter three, this study responds to the need to improve research performance at SQU. It has some practical implications for SQU research administration, as follows:

- SQU has to specifically decide on what kind of success it aims for (output or impact). Aiming at “Institutional economic benefits”, “Educational contributions”, “Broader social benefits” and “Policy benefits” would require more consideration during the resource

allocation processes and the internal research evaluation exercises than if “standard success measures of project success” and “Knowledge production” were the target;

- SQU needs an awareness campaign to educate its faculties not only on project management issues but also on issues of how to manage human behaviours such as conflict and negative use of political skills; and
- In the long term plans, SQU should reflect its research strategy in staff recruitment. SQU should, mainly, hire researchers who have expertise in fields that are expected to serve Oman.

## **8.4 RESEARCH LIMITATIONS**

### **8.4.1 Researcher’s bias**

The limitations of this study are acknowledged. Some of these limitations are due to inherited biases in the nature of qualitative research and the involvement of the researcher. To minimise the bias of selecting certain researchers, the interviewees were randomly selected with the use of “**Super Cool Random Number Generator**” software. Semi-structured interviews can allow for researcher bias in leading the direction of the questions. In addition to social desirability bias to select certain answers supplied by the interviewees (Bryman and Bell, 2007). To minimise these biases, the interviews were semi-structured where the same questions were asked at every interview. In addition to a number of probing questions such as what do you mean, could you elaborate more? or asking for specific examples of incidences and behaviours, in order to clarify their meanings. Whilst the semi-structured nature allows for some deviation, the majority of the interviews are consistent. Rather than divide his time split between listening and taking notes of what was said the researcher digitally recorded the interviews and this allowed him to pay full attention and actively listen to the interviewees.

In addition the recorded interviews were transcribed, repetitive re-reading of the transcripts also helps address issue of researcher bias. The results of

consistency tests indicate that researchers' bias is minimised through stable findings by the researchers (intra-rater test) and reproducible results by another auditor (inter-rater test). The researcher self - reflection to identify sources of bias or predispositions towards/against the object of research reduces, further, the researcher's bias. This self-reflection process is apparent in the comprehensiveness description of the research methodology and findings.

### **8.4.2 Context based limitation**

The limitations of this research are due to the nature of its context. Data is collected from a single organisation which makes research findings less generalisable to wider populations of organisations. Generalisation of the findings, however, is not an aim in this study. The purpose is to understand the underlying mechanism and structures of implementation effects on R&D performance in SQU. This objective makes in-depth understanding more relevant than generalisation. Good descriptive or analytic language by which one can grasp the important characteristics of the implementation does, however, offer reasonable possibilities for generalisation (Gummesson, 2000).

### **8.4.3 Recommendation for future research**

The research findings open up numerous avenues for future research. Moreover, whilst this research shows how research staff at SQU believe R&D performance is influenced by its implementation, and provides a list of success measures, future research could determine the actual existence of these measures and obtain quantitative correlations between effects and measures. This would help to find which measures are more influenced by which effect. A developed model could be tested for statistical generalisation in positivist quantitative research. In addition, it would be of interest to extend the issues discovered and explored here to other settings in the search for more broadly based associations and relationships.



Measures found here are categories of success not indicators of one. Each measure should have some indicators. For example, Kerssens-van Drongelen and Cook (1997) used qualitative measures, such as market success, as performance criteria. They used quantitative indicators such as sales' increase, market share and customer perception. Knowledge production is indicated differently by different measurement systems such as the quality of the journals in which publications appear, or by bibliometric indicators such as citations. It suggested that a study on how to indicate the measures derived here would be fruitful.

## **8.5 CHAPTER SUMMARY**

This chapter concludes this thesis. It provided an overview of the study's findings. It then discussed the contributions of this research to both academics and practitioners. The chapter then highlighted the limitations of this research and proposes some future research topics.



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## APPENDICES

297. **Appendix A:** Forms used in administration of SQU research

F1

**For Office Use**

**Sultan Qaboos University  
Postgraduate Studies and Research  
Research Proposal**

PRINCIPAL INVESTIGATOR		
Family Name	Given Names	Date
Department	Position	Telephone E-Mail
CO-INVESTIGATORS (other investigators contributing significantly to the proposal)		
Name:	Name:	
Department:	Department:	
Name:	Name:	
Department:	Department:	
GRANT REQUESTED (RO)		
Year 1:	Year 2:	Year 3:
SHORT TITLE		
SUMMARY		
Does the proposal need to be cleared by the University Ethics-In -Research Committee?		
SIGNATURES		
_____ Principal Investigator	_____ Head of Department	_____ Dean

<b>OUTLINE OF PROPOSED RESEARCH</b>				
Proposed research outline must include a literature review, long and short term goals, protocol, practical significance of outcome and pertinent references. Maximum of 3 pages of at least 10 point font, single spaced, Times Roman.				
<b>SUMMARY OF FUNDS REQUESTED (R.O.)</b>				
	Year 1	Year 2	Year 3	TOTAL
Capital Equipment				
Recurrent Items (Consumables)				
Computing Costs				
Use of University Facilities				
Conference Attendance and Travel				
Local Travel and Transport Costs				
Insurance				
Research Assistants/Consultants				
Publication Costs				
Miscellaneous				
<b>TOTAL</b>				
<b>PERSONNEL TIME ALLOCATION</b>				
	Year 1 (Hrs/Wk)	Year 2 (Hrs/Wk)	Year 3 (Hrs/Wk)	
Principal Investigator				
Co-investigator				
Co-investigator				
Technician				
<b>Project Costs Breakdown (R.O.)</b>				
<b>CAPITAL EQUIPMENT</b>	Year 1	Year 2	Year 3	TOTAL
<b>Subtotal</b>				
<b>RECURRENT ITEMS(CONSUMABLES)</b>	Year 1	Year 2	Year 3	TOTAL
<b>Subtotal</b>				
<b>COMPUTING COSTS</b>	Year 1	Year 2	Year 3	TOTAL
<b>Subtotal</b>				
<b>USE OF UNIVERSITY FACILITIES</b>	Year 1	Year 2	Year 3	TOTAL
<b>Subtotal</b>				
<b>CONFERENCE ATTENDANCE AND TRAVEL</b>				
	Year 1	Year 2	Year 3	TOTAL (RO)
<b>Destination</b>	Estimated Expenses	Estimated Expenses	Estimated Expenses	
Within Oman				
Overseas				
<b>Subtotal</b>				
<b>LOCAL TRAVEL AND TRANSPORT COSTS</b>				
	Year 1	Year 2	Year 3	TOTAL (RO)
<b>Destination</b>	Estimated Expenses	Estimated Expenses	Estimated Expenses	
<b>Subtotal</b>				
<b>INSURANCE</b>	Year 1	Year 2	Year 3	TOTAL
<b>Subtotal</b>				

**Effects of R&D Implementation on the Performance of Publicly Funded Research in SQU**

<b>RESEARCH ASSISTANTS/CONSULTANTS</b>					
Name	Country	Present Position	Period of Visit	Expenses (R.O.)	Sponsors
<b>Subtotal</b>					
<b>PUBLICATION COSTS</b>	Year 1	Year 2	Year 3	<b>TOTAL</b>	
<b>Subtotal</b>					
<b>MISCELLANEOUS</b>	Year 1	Year 2	Year 3	<b>TOTAL</b>	
<b>Subtotal</b>					
<b>GRAND TOTAL</b>					

*Collaboration*

1. Are there expected to be any collaborative arrangement in existence relating to the Research Project?
2. Name and address of the collaborating organization :

Name of the Organization/Institution	Address

3. *Contribution provided by Collaborating Organization*

Particulars	Year 1	Year 2	Year 3	Total (RO)
(i) Consumables				
(ii) Use of Facilities/Equipment				
(iii) Others (specify)				
(iv) Total Contributions				

**End of Form 1**

F2

**For Office Use**

**Appl. No:**

**Sultan Qaboos University  
Postgraduate Studies and Research**

**Personal Data**

Family Name		Given Names		Department	Position
Telephone			E-Mail		
<b>DEGREES</b>	<b>College, University, Institution</b>	<b>Country</b>	<b>Year</b>		
Master					
Doctorate					
Other					
<b>TEACHING, RESEARCH AND INDUSTRIAL EXPERIENCE</b>					
Positions Held	Dates	Department	Institution		
<b>RESEARCH TRAINING INFORMATION</b>					
				Master	Doctorate
Number of graduate degrees conferred upon students under the Applicant's supervision during the past six (6) years _____					
Number of graduate students currently supervised by the applicant _____					
<b>SIGNATURE</b>					
_____		_____			
Signature		Date			
<b>SIGNIFICANT RESEARCH CONTRIBUTIONS (last 5 years only, including this year). Maximum of 2 pages.</b>					
(List all publications that you have authored/co-authored using the following categories: Refereed Journal Publications, Books/Chapters of books, Refereed Conference Proceedings, Patent applications):					

**End of Form 2**



F3

**Sultan Qaboos University  
Postgraduate Studies and Research  
Research Proposal Evaluation Form**

<b>Project Title:</b>
<b>Project Number:</b>
<b>Principal Investigator:</b>
<b>Date:</b>

A) Please give your comments on the following

*Originality:*

---

\_\_\_\_\_

*Scientific Merit:*

---

*Relevance to Oman:*

---

*Qualifications of Investigators:*

---

*Methodology:*

---

*Budget:*

---

*Clarity of Presentation:*

---

*Improvement of the research proposal:*

---

B) Based on your comments, please fill the following form:

EVALUATION	Excellent	Very Good	Good	Fair	Poor	Unable to Judge
Originality						
Scientific Merit						
Relevance to Oman						
Qualifications of Investigators						
Methodology						
Budget						
Clarity of Presentation						

C) Please give your general recommendation:

## Appendices

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<input type="checkbox"/>	Acceptance
<input type="checkbox"/>	Acceptance with revision
<input type="checkbox"/>	Extensive revision needed before decision can be made
<input type="checkbox"/>	Rejection

### **REVIEWER'S DETAILS:**

Reviewer's Name:	Address:
Reviewer's Signature	Date

***End of Form 3***

F5

**Sultan Qaboos University  
Postgraduate Studies and Research  
Annual Progress Report**

<b>PRINCIPAL INVESTIGATOR</b>			<b>PROJECT CODE</b>	
Family Name	Given Names	College	Department	
<b>CO-INVESTIGATORS</b>				
Family Name	Given Names	College	Department	
<b>PROJECT TITLE</b>				
<b>Amount allocated</b>			<b>Actual expenditure</b>	
<b>SUMMARY</b>				
Please state what you are doing, why you are doing it and significant results over the past year. Have all of last year's objectives been achieved? Any deviations from the original proposal?				
<b>SIGNATURE</b>				
_____ Principal Investigator                  Assistant Dean (PGS&R)                  Date				
<b>PLANS FOR CONTINUATION OF PROJECT</b>				
Outline specific objectives over the coming year.				
<b>PUBLICATIONS</b>				
List all relevant publications that you have authored/co-authored in the last year using the following categories: Refereed Journal Publications, Books/Chapters of Books, Refereed Conference Proceedings, Patent Applications, Submitted Papers.				

**End of form 5**

F6

**Sultan Qaboos University  
Postgraduate Studies and Research  
Annual Progress Report Evaluation**

<b>Project Title:</b>				
<b>Project Number:</b>				
<b>Applicant:</b>				
<b>Date:</b>				
<b>EVALUATION</b>	Excellent	Good	Poor	Unable to Judge
To what extent were the proposed objectives met for the evaluation period?				
Has the project been executed according to the proposed research plan?				
Is the project generating publications at an acceptable rate?				
Has the teaching and research capability of the University been advanced as a result of this project?				
Has a basis been established for continuing research support in this field?				
Does this project help in generating knowledge of relevance to the Sultanate of Oman and in the region?				
<b>REVIEWER'S COMMENTS</b>				
Reviewer's Name:		Address:		
Reviewer's Signature		Date		

***End of form 6***

**F7**

**Sultan Qaboos University  
Postgraduate Studies & Research  
Project Final Report**

**Project Information**

Title: \_\_\_\_\_ Project Code: \_\_\_\_\_  
 Date of Commencement: \_\_\_\_\_ Date of Completion: \_\_\_\_\_  
 (DD/MM/YY) (DD/MM/YY)  
 Approved Budget: \_\_\_\_\_ Total Expenditure: \_\_\_\_\_

**Researchers**

(1) Principal Investigator

Family Name: \_\_\_\_\_ Given Names: \_\_\_\_\_ SQU ID No.: \_\_\_\_\_  
 College: \_\_\_\_\_ Department: \_\_\_\_\_ Academic Post: \_\_\_\_\_  
 Email: \_\_\_\_\_ Phone No: \_\_\_\_\_ Employment Date: \_\_\_\_\_  
 Number of hours/ week: \_\_\_\_\_  
 (Hours/Week)

Other ongoing research (if applicable):

Project Code	Hours/Week

(2) Co-Principal Investigator (if applicable)

Family Name: \_\_\_\_\_ Given Names: \_\_\_\_\_ SQU ID No.: \_\_\_\_\_  
 College: \_\_\_\_\_ Department: \_\_\_\_\_ Academic Post: \_\_\_\_\_  
 Email: \_\_\_\_\_ Phone No: \_\_\_\_\_ Employment Date: \_\_\_\_\_  
 Number of hours/ week: \_\_\_\_\_  
 (Hours/Week)

Other ongoing research (if applicable):

Project Code	Hours/Week

(3) Co-Investigator(s) (Please list all Co- investigators in the project following the same format)

Family Name: \_\_\_\_\_ Given Names: \_\_\_\_\_ SQU ID No.: \_\_\_\_\_  
 College: \_\_\_\_\_ Department: \_\_\_\_\_ Academic Post: \_\_\_\_\_  
 Email: \_\_\_\_\_ Phone No: \_\_\_\_\_ Employment Date: \_\_\_\_\_  
 Number of hours/week: \_\_\_\_\_  
 (Hours/Week)

Other ongoing research (if applicable):

Project Code	Hours/Week

**Expenditure**

**Detailed Expenditure**

(Give details of actual expenditure for each item in the project).

Items	Amount

## Appendices

Capital Equipment	
Recurrent Items (consumables)	
Computing Costs	
Use of University Facilities	
Conference Attendance & Travel	
Local Travel & Transport costs	
Insurance	
Research Assistants/ Consultants	
Publication Costs	
Miscellaneous	
Total	

### Research Equipment

Please list all equipment purchased or utilized in the project with the required materials. *(If applicable)*  
Purchased Equipment (Project-Capital Equipment)

Equipment Name	Location	Status

### University Equipment (Use of University Facilities)

Equipment Name	Location	Status

### Research Collaboration

Please list all collaboration you had with an international /local institution either on personal or official level. *(If applicable)*

Type of Collaboration	Collaborator (Person Name or/and Organization)

### Contracts

Please list all contracted work of the project. *(If applicable)*

Contracted work	Contractor	Contract Value (R.O)

### External Fund/Support

Please list all funds/support the project received. *(If applicable)*

Type & Value of Funds/ Support	Organization	Started Date	Finished Date

### Marketing Initiatives

Please list all your marketing initiatives to deploy the project's finding. *(If applicable)*

Initiatives	Organization (Public or Private)	Results of Initiatives

**Publication & Research Output**

Please list and provide hard copy of all relevant publications that you have authored/co-authored from the project using the following categories: Refereed Journal Publications, Chapters of Books, Refereed Conference Proceedings, Patent Applications, Submitted Papers. List all publication with the report in this format:

- Journal Publications: (Author (s), Title. Journal - Vol., No. (Year).
- Conference Participation: (Author (s), title of presentation, conference title, place, date)
- Patent: Number, topic, place.

**Summary of Research Project**

Please provide the following information in separate paragraph, (Hard & electronic copy):  
Summary. Please state what you have been doing and the significant results achieved.

Introduction & literature survey.

Methodology.

Results findings & analysis.

Conclusions.

Keywords (Please provide keywords that describe the nature of the research project).

Organizations that benefited or could benefit from research output.

**Declaration**

Principal Investigator Name: \_\_\_\_\_ Signature: \_\_\_\_\_ Date: \_\_\_\_\_

Assistant Dean Approval (PGS&R): \_\_\_\_\_ Date: \_\_\_\_\_ Stamp \_\_\_\_\_

**General Guidelines**

1. Principal investigator is responsible to submit to the Office of Deputy Vice President for Postgraduate Studies & Research the final report after the completion of the project
2. Electronic version of the final report will be published on DVC-PSR website.
3. All equipment must be returned to the person in charge in the college upon the completion of the research project.
4. All contracts should be closed before submitting the final report.
5. Failure to submit a final report by the due date will jeopardize the college/department/ researcher's eligibility for future grant support.

**End of form 7**

F9A

**Sultan Qaboos University  
Research Contract Agreement Form**

SPONSOR FILE NO.		SQU PROJECT CODE	
PROJECT TITLE			
SQU PROJECT LEADER			
Name:			Position:
Department:			College:
Telephone:	Fax:	Address: P.O. Box: ....., Al-Khod	
Postal Code 123, Sultanate of Oman			
CO-INVESTIGATORS			
Name:			Name:
Institution:			Institution:
Position:			Position:
Telephone:	Fax:	Telephone:	Fax:
SPONSOR'S MAIN CONTACT			
Institution:			Full Address:
Name:			Position:
Telephone:			Fax:
ESTIMATED PROJECT COST	EXPECTED PROJECT DURATION		
PROJECT SUMMARY			
CONFIDENTIALITY AND INTELLECTUAL PROPERTY DECLARATION			
<p>It shall be the responsibility of the University Project Team, including subcontractors, to treat the details of this Research Project as confidential, save in so far as may be necessary for the performance of their duties, and not to publish or disclose the same or any particulars thereof in any trade or technical paper or elsewhere without the previous consent in writing of the University. The Project Team shall also fully respect the intellectual property rights of the University for all results arising from this project, and shall not make any use of such results for private or commercial gain without an official license from the University.</p> <p>Accordingly each member of the University Project Team will be required to sign a "Confidentiality and Intellectual Property Declaration" in connection with this project.</p>			
WORK DESCRIPTION			
<p>Technical and Business Background</p> <p>Problems to be addressed</p> <p>Research Methodology (Protocol)</p> <p>Anticipated Results</p>			
MILESTONES AND DELIVERABLES			
PAYMENT SCHEDULE	Amount (R.O.)	Timing	
Initial Payment		<i>(Upon signing the Agreement)</i>	
Interim Payments:			
First			
Second			
.....			



**Effects of R&D Implementation on the Performance of Publicly Funded Research in SQU**

Final Payment		<i>(Upon completing the Project) With a Release Letter from the Sponsor</i>			
Project Short Title and Code:					
<b>BUDGET</b>					
Personnel	No. of Hours	Hourly Rate (R.O.)	Project Cost (R.O.)	SQU Share (R.O.)	Financial Code
Project Leader					
Co-Investigators					
Research Assistants					
Technicians					
Secretaries					
Total Personnel Costs					01
Overhead @ 40% of Total Personnel Costs					03
Capital Equipment					04
Recurrent Items (Consumables)					05
Fees for Use of University Facilities					06
Conference Attendance and Travel costs Outside Oman					07
Local Travel and Transport Costs					07
Computing Costs					08
Insurance					09
Sub-contractors and Consultants					
a) Local					10
b) Foreign					10
Publication Costs					11
Miscellaneous					11
TOTALS					
AMOUNT PAYABLE TO SQU (Project Cost – SQU Share)					R.O.

<b>FINANCIAL EXPENDITURES</b>
<i>Details of Proposed Expenditure</i>
<b>PERSONNEL</b>
<i>Names of Project Team members and areas of specialization</i>
<b>NON-DISCLOSURE OBLIGATIONS</b>

During the period of performing this Project, the University and the Sponsor (the parties) may be disclosing relevant Proprietary Information to each other. Prior to any disclosure of such information the Sponsor shall indicate its intent to disclose Proprietary Information to the University Project Leader, who shall have the right to decline receipt of such information. Each party agrees to treat Proprietary Information received from the other with the same degree of secrecy with which it treats its own Proprietary Information and further agrees not to disclose such Proprietary information to a third party without prior written consent of the disclosing party, except if such Proprietary Information

- was known to the recipient prior to the disclosure hereunder;
- was received from a third party not under an obligation of confidence to recipient; is in the public domain at the time of disclosure hereunder or subsequently entered the public domain without the fault of the recipient;
- has been independently developed by an employee of a recipient that has not had access directly or indirectly to such Proprietary Information and recipient can substantiate any claim of independent development by written evidence; or
- is required to be disclosed by law.

**INTELLECTUAL PROPERTY RIGHTS**

All rights and titles to intellectual property arising from this Project shall vest in the University. Such intellectual property shall include copyright of any reports, documents and computer software prepared by the University under this Project, as well as any new development of products or processes and any improvements to publicly known products or processes. The Sponsor shall have a non-exclusive non-assignable license to use such intellectual property.

**ACQUISITION OF CAPITAL EQUIPMENT AND SOFTWARE**

All items of capital equipment and computer software purchased for the purposes of this Project using the Sponsor's funds will become the property of the University. The cost of maintaining such capital equipment will be a charge against this Project for the Project duration. After completion or termination of the Project, the University will be responsible for maintaining the equipment.

**INDEMNITY**

The Sponsor shall fully indemnify and hold harmless the University against all claims arising out of the Sponsor's use, commercialization or distribution of information, materials products or processes which result in whole or in part from the activities performed under this Agreement. The Sponsor shall hold the University harmless from any claims arising from third party claims that the work performed hereunder infringes third party intellectual property rights.

**SIGNATURES AND SEALS**

Project leader Signature: Name: Date:	Head of Department Signature: Name Date:
Dean of College Signature: Name: Date:	Authorized SQU Official Signature and Seal: Name: Title: Date:
Authorized Sponsor's Official Signature and Seal: Name: Title: Date:	Sponsor's Witness Signature: Name: Position: Date:

***End of from 9A***

F9B

**Sultan Qaboos University  
Support Service Agreement Form**

SPONSOR FILE NO.		SQU PROJECT CODE	
PROJECT TITLE			
<b>SQU PROJECT LEADER</b>			
Name:	Position:		
Department:	College:		
Telephone:	Address: P.O. Box: ....., Al-Khod		
Fax:	Postal Code 123, Sultanate of Oman		
<b>SPONSOR'S MAIN CONTACT</b>			
Institution:	Full Address:		
Name:	Position:		
Telephone:	Fax:		
<b>ESTIMATED PROJECT COST</b>		<b>EXPECTED PROJECT DURATION</b>	
<b>PROJECT SUMMARY</b>			
<b>CONFIDENTIALITY AND INTELLECTUAL PROPERTY DECLARATION</b>			
<p>It shall be the responsibility of the University Project Team, including subcontractors, to treat the details of this Research Project as confidential, save in so far as may be necessary for the performance of their duties, and to not publish or disclose the same or any particulars thereof in any trade or technical paper or elsewhere without the previous consent in writing of the University. Furthermore, the Research Team shall not make any use of any results arising from this project for private or commercial gain without an official authorization from the University. Accordingly each member of the University Research Team will be required to sign a "Confidentiality and Intellectual Property Declaration" prior to working on this project.</p>			
<b>WORK DESCRIPTION</b>			
<p>Technical and Business Background</p> <p>Services to be provided</p>			
<b>MILESTONES AND DELIVERABLES</b>			
<b>PAYMENT SCHEDULE</b>	<b>Amount (R.O.)</b>	<b>Timing</b>	
Initial Payment		<i>(Upon signing the Agreement)</i>	
Interim Payments:			
Final Payment		<i>(Upon completing the Project) With a Release Letter from the Sponsor</i>	

Project Short Title and Code:					
<b>BUDGET</b>					
Personnel	No. of Hours	Hourly Rate (R.O.)	Project Cost (R.O.)	SQU Share (R.O.)	Financial Code
Consultant					
Assistants					

**Appendices**

Technicians					
Secretaries					
Total Personnel Costs					01
Overhead @ 40% of Total Personnel Costs					03
Recurrent Items (Consumables)					05
Fees for use of University Facilities					06
Local Travel and Transport Costs					07
Computing Costs					08
Insurance					09
Miscellaneous					11
TOTALS					
AMOUNT PAYABLE TO SQU (Project Cost – SQU Share)					R.O.
<b>FINANCIAL EXPENDITURES</b>					
<i>Details of Proposed Expenditure</i>					
<b>PERSONNEL</b>					
<i>Names of Project Team members and areas of specialization</i>					
<b>NON-DISCLOSURE OBLIGATIONS</b>					
<p>During the period of performing this Project, the University and the Sponsor (the parties) may be disclosing relevant Proprietary Information to each other. Prior to any disclosure of such information the Sponsor shall indicate its intent to disclose Proprietary Information to the University Project team, who shall have the right to decline receipt of such information. Each party agrees to treat Proprietary Information received from the other with the same degree of secrecy with which it treats its own Proprietary Information and further agrees not to disclose such Proprietary information to a third party without prior written consent of the disclosing party, except if such Information:</p> <ul style="list-style-type: none"> <li>- was known to the recipient prior to the disclosure hereunder;</li> <li>- was received from a third party not under an obligation of confidence to recipient;</li> <li>- is in the public domain at the time of disclosure hereunder or subsequently entered the public domain without the fault of the recipient;</li> <li>- has been independently developed by an employee of recipient that has not had access directly or indirectly to such Proprietary Information and recipient can substantiate any claim of independent development by written evidence; or</li> <li>- is required to be disclosed by law.</li> </ul>					
<b>COPYRIGHTS</b>					
All copyright of any reports, documents and computer software prepared by the University under this Project shall vest in the University. The Sponsor shall have a non-exclusive non-assignable license under such copyright to reproduce, adapt, translate and distribute any such reports and documents.					
<b>SIGNATURES AND SEALS</b>					
Project Leader Signature: Name: Date:			Head of Department Signature and Seal: Name: Date:		
Authorized Sponsor's Official Signature and Seal: Name: Position: Date:			Sponsor's Witness Signature: Name: Position: Date:		

**End of form 9B**

Appendix B: Sample of interview transcript

Interview Number: 03

Place: SQU

Date: 12/10/08

Time: 12:00

Interview Length: 65 min.

**Respondent's background:**

Job title: Academic of Applied Science    Rank: Associate Professor

Gender: Male

Experience: Teaching, research and administration.

---

***Q1. What is the most important part in the process of selecting research at SQU?***

Competition, What I am trying to say is that the competition is poor. Research plan is poor, all because there is a lack of competition. Almost everybody who proposes wins a project. Why the competition is poor? It is not because the faculties are poor. It is because I think there are some very good faculties do not bother to compete. They do not bother to write decent proposals and win a grant. They do not see tangible benefit for their efforts. That's what it is. If I write a proposal and I mean it and I expect some reward at the end of the day and I do not see the reward then I'm not going to bother about it. If I feel... look whatever I do, I will get my salary and that this... you know. That's what I am going to do I will withdraw myself from competition. Often faculty gives the administrative difficulties in terms of documents and paper work as a reason, for not competing. But I do not think that's a fair reason. I think the administrative reforms in the university are quite modest by an standard. I have worked many research organizations... we I expect these people to write proposals, get reviewed. These are the standard practices, very modest. I do not think that is a real reason. I think everyone admits procurement is a problem. I think

somebody has to do something drastically about it. That is a problem, but at the end I don't see any major ban in it from at the administrative side.

Why people don't compete is largely people feels secure in their jobs. Their jobs are not threatened. No Omani can be fired. Their job is guaranteed for life once they get into the job. Why should he bother? You got a job. You are promoted. You get extra 50-60 Rials per month. I have family and children. I think one of the reason why Omani faculty don't get into serious competition. It is... they are quite relaxed about their level of security in their positions and therefore, they will not compete right. Expats do compete. . You will see that almost all the major projects are owned by the expats. Partly because they are old as senior people and omanis are younger people and that they will compete. Here the rewards are expats. Don't worry. I am crack I am saying this or not. I don't even know what young omani faculties will meat as an incentive to do. There are plenty of of incidents they can go for confidence, money for entertainment. Still they don't do. Still they are comfortable with their life style with their salaries. Expats some are upto it, some are not. I don't know why they don't compete. I think specially if you look into the proposals for HM and if you will look at the proposals largely written by associate professors who want to become fulfilled professors. Largely you will not find too many professors fulfilled professors largely. They are comfortable. Because I got my promotion, I am done. In our college we have full pledge professors. Only Bassam has HM project, Hamphrei has now one. He was forced to take one and Anwar don't have one but Anwar does lot of work for PDO. They really don't bother; they do not see the worth for it. And so the people and even the people who... and the promotion system here rewards people who does research in terms of number of research papers. Number of research papers are directly related to me if I have a small project, I can write a paper where a large project it does not mean that I can write ten papers, I can still may write a 3-4 papers so the amount of works that is involved to run a large one to manage a large one the number of papers that I get out of it is not proportionate to the time we invest in it. Person who does a small experiment or small project has a lot of chances to win it. So in our promotion system we tend to give probably a number of papers and work a

small experiments in a lab whatever... whatever our competition relation and we count them and you don't give weight to the life who went out to put a team together and a proposal together and applied. So that turns you off after sometime and that is the reason why we don't get good proposals and good proposal selection. And I think our college is in better side although we do not compete to my preferred level, more than other colleges and that is reflected in HM projects. You will see all these projects are written well and reviewed better and we get the finding. That's the fact despite the small college. We are able to identify apply the problem and we are able write the proposals for solution and we are able to convince the right people.

**Q2. *And when you say good proposals what do you mean?***

**A2.** I think the proposal is basically to identify a problem to which reviewer can relate to. You see, I can write about some differential equations and solve it but as a good reviewer you are not going to give a lot of weight for it to warrant an HM project. You will be happy give an internal grant. That's what I am talking about. We as an applied scientist, agriculture and marine science we are able relate to problem what common man can relate to. And we will have short term impact on the common man in short period of time whether it is greywater or witch broom or mango disease or sudden death in mango whatever we can relate to hopefully. I think that is the centre of our college and other colleges due to some reasons they just don't do it. I don't think they come up and sometimes I'm really appalled about the types of proposals come from other colleges. You know there were the times I was in the middle of review and in the last ten minutes. A colleague joined without naming him presented his proposal, basically I was asking, tell me what are you trying to research? What is the research question you are addressing? And there was no answer. He could not tell me what was the research objective. He just put together a proposal and thought that I should be able to get it he had done blaa blaa blaa and he has come, he failed very miserably. Anyway that is one case. What I am trying to say is here there is not enough competition, not because they are not talented, They just don't compete and write good proposals. The

incremental rewards are not seen something worthy doing it. I have some omani faculties are telling it that, ok, you will become associate professor I will get 30-60 rials increments a year. Why? This guy is an intelligent. I will go to the stock market and make money. Why should I worry? That is see unfortunate part of care people think. People don't see the academic pursuit as personal obligation and will do it for their satisfaction and people owns PhD for the sake of having PhD and social status and all those things. People don't see PhD the point from where they start to do research, they thing that's an end to do research. That's the thing. Having said that, the younger fellows the new omanis the young omanis are new different breed . The new omanis when I say these guys got BSc from SQU going out doing MSc and PhD and coming back. I think they are fire breed. There are few people in our college we will find in few years from now will do very better. Without giving names the people who contributed in last two three years they come back with right attitude.

**Q3. *What makes them different?***

A3. I think they are fresh from the PhD and they feel that they are equally good as any expat otherwise and they are very good. They know they are good. Their English is good and project formulation is good. They are dedicated and willing to put extra hours and since, these younger crowd they see this as a career progression. But the people who are graduated 10 years ago or 20 years ago who didn't study at SQU at all and come from outside. Their attitude is different. Honestly I am telling, their attitude is that PhD is like a patch they ware But the younger fellows are very different. I think 4-5 people are very very different and they are going to be very good. The lull be seen is temporary. I hope. When these guys come up and pushed, being appreciated doing well and well and well. One of the reasons is that why the other people do not concentrate on research I think was that even without doing good research some of them got good posts and they hope this will happen to them also. Like when you become president or vice president and all those things that was happening here and they are assuming that ok. I'm one of the first omanis with



PhD I will be the HoD, the Dean but all these things will not happen. I think it's good that this it's not happening. Only the qualified people should be promoted and there was a time 4-5 years ago when I came all the assistant deans were Omanis. Now our bosses said necessary to be Omanis, Someone who can do the job well so that opens for the expats. And then even among Omanis they say that they don't want this job. If I get this job, I will not get my research done and I will not get promoted. They are now interested in research rather than getting posts. And this time initially each position we suppose to nominate 3 people for assistant dean I could only nominate two, I could not find the third guy yaa I am interested. And the guy I nominated an expat and he got the job. Omanis the young Omanis are new breed. They are not interested in this title. They don't see. I think that is the lesson for what happened during last 5- 10 years. Now influencing the current guys. I am hopeful that in future from now I think we will have better project and better proposals. There has to be some stick in the system. You have carrots in the system there has to be some stick, if they don't do they should be under scrutiny. Why have you not done, where is research ! There should be some stick. It is not yet. There should be some stick. You cannot touch anybody. You cannot reprimand anybody. If you reprimand anybody, you will become a bad guy. If I call associate professor, look man you are not well. I will be bad guy. My strategy is that if somebody doing well, I will say hey you are doing well is there any thing that I can help you with. Others turn around and look for. That's my strategy. I look for young fellows who are doing well and giving them a pat and others observe and try get. I cannot go to the guy who does perform and say you are not performing. I cannot say that. Clear in mind. I think that is not desirable. I think that is not applicable researchers. It is applicable right across the university. I obviously say that every year the university say that we are going to lay off 0.1% of their staff. According to staff, university will go 100% forward. You just say 1% of 3000 people in the university, means 1/% is 30 people. I am sure 30 people in the university. I am sure that 30 people are performing somewhere I could be clerk, Associate professor and whatever. We are going to identify the worst performance of 30 people and let them go home. It will change everybody but I

think we can not do that because it is a government policy. That's the government policy of oman .That part we don't have. We would talk about project selection. So lets get back to that point. What can we do make it more challenging? I don't think the money is real issue in Oman. The issue really is that the lack of competition. People don't like to compete. There is enough for everybody to go around. I think if university can develop research grades for university technicians, administrators and faculties, If that comes in that should help. Other thing is that they should open up for international students and give them scholarships. Then it catches up. And when they work with these guys, the younger guys would think why should we came, when they work with, they can equally do good. That kind of think should be there to help.

**Q4. At College level What is the current process for selection, selecting projects?** The proposals written, reviewed by committee here like I said we get 10 proposals each one gets 5000-10000 rials. There is no competition. There is no rejection. You don't reject anybody. We also have sense of fairness. Something you said somebody is new, he would given a new project we are a small college in the university there are 60 seats. Everyone can hold two projects each, We cannot ask more than that. We are almost fulltime teachers. And whatever research is done.

**Q5. When the committee looks on the proposals based on what it decides that this is a good proposal and this is not?**

A5. I think the standard practices here are used. I think I slightly changed when I was a chairman of college committee, we tried to look into track record ... and still it comes back to, there is nothing to reject the kind of a thing. I will give you simple calculation we have 60 grades in this college, 50% of the time they are supposed to teach. So I'm left with 30 researches. 25% are supposed to do services and whatever. So this college has got 15 researchers, 15 fulltime researchers. We have at least in my books, 50 projects I have 9 HM project in this college and about 30-40 IGs. just. 15 full time people what more they can give.

**Q5. If you to select the projects that are good ones, what would be the criteria?**

A5. I would always go for impact. Impact that is to me the good projects that should be clearly defined out product. It can be newly differential equations verbally, clearly defined no matter how small that can be. Like our project the greywater we designed something that works, it is not a nuclear science, but it works. When I go to people, I can show them that it works. I think that's what we look for in good project this is something good clearly defined outcome was there. Many people get excited with output. Output is papers, how many papers you write. That's ok. But there should be an outcome from the projects. I think that should be there. One more thing I would also like to mention to you is that we talk about that some people can produce papers from small projects. That's what being rewarded and that's where we are unable to deliver outcome. Let me explain this to you when I have an HM project there can be clear outcome for someone to implement, if I have a 5 k project there is nothing as an outcome for someone to implement there will be some output some papers to publish and because only the output is being rewarded in the system researchers do not even think about the outcome. When I became the dean I told all the 9 HM PIs that it was nice to put proposal together and get the money now it is your responsibility to put some outcome on the ground. 5 year down the road they might turn on us and say look we gave you almost a million Rials what did you give us in return, can we just say we published 10, 20 papers, is that the right thing for me to say?.. no. we said clear output but also clear outcome. how to ensure an impact from day one, many researchers finish their research and then they start thinking about implementing it and by the time they up to something they run out of time and money so nothing is being implemented. If a researcher can think of implementation from day one then he can put good proposal and can show people that there is some thing they can adopt. It is the fault of the researchers they do not think about implementation from day one they only think about it at the end on the project this is the traditional model, we do the research then we give to the extension people to develop, nowadays that time is not available you need to do all together you do

not have ten years to do a project, you only have 3-5 years to do it. This is the reason why we are unable to show some impact. I'm talking to my staff now changing our strategy through my commitment as management and leadership responsibility towards improving the college research performance in SQU.

**Q6. *What is required to deliver that kind of research?***

A6. I will tell you what is required that we don't have here in SQU we don't have time to set and talk science. The first thing I changed when I came to this position is that I freed all academics in the college for one hour in Monday to set and talk science so every week we have a seminar in the college, second thing I said anyone who goes to present a conference paper has to present it on that day, interestingly they all collaborate they do not complain.

**Q7. *What are those factors, apart from being good proposal, that would lead to successful research?***

A7. Of course you need good proposal to have good project. How the project is implemented makes difference... you need to see your research team and make sure that everyone is getting something from the project. You need to develop that sense of ownership, whether a student who is getting a degree or academic who is getting a paper or conference trip whatever, they all have to be satisfied. Often the funding agency is detached from the project, Research administrators are not experts in the field they are like project managers but not into the subject so they send it to experts for review, but the review of the project need to be continuous during the project life but we are not equipped to do it. The system now that every year PI writes a report which need to be reviewed by the CRC and they do a very shallow job, I think they do not do a decent job and to be honest the CRC is not the right one to review the progress report, they are not qualified to review reports of project in completely different fields. So there must be a mechanism to do that. We argue now to have themes in our college, which will enable doing thematic reviews by that I mean all those subfields will be reviewed by the main theme specialists and how they are related to it. You know when we reviewing the SQU research strategy the

committee worked well on most of the issues but when it came to setting the research theme it lacked leadership, it made up a wish list of themes for all departments. The list was very long and themes were not related, now we are asked to reduced this list. This what I was asking the committee to do. what is the criteria to come up with a theme? The chairman will end the discussion and nobody wants to challenge him?

**Q8. *Why they did not challenge him?***

A8. They did not want to challenge him because he is a professor and more senior he is a dean you see, out of 9 deans in the university he is the most senior one. The point here is that. The chairman will call for votes without discussion he does not like to discuss issue so he will get his group (friends and other) and will just get the committee to approve what he wants. It is one man show and that is the case with most of the other committees as well.

Let us go back to our discussion here, we need thematic review not the usual CRC reviews. For example we have 15 experts in water related theme 6 in this college, 9 distributed in other colleges in SQU, they should be reviewing the reports not the CRC. Now would it work that is something else. You see if it was up to me I would only give HM projects to the research centers only, these centers have to pull teams from different colleges that way we will have better chance of having good research performance in terms of impact, the centers would pool the academics, technicians, admin staff all other resources. Yes the deans and the directors have to work together to make this work, the centers are not equipped the college are therefore they need to collaborate and be committed to research actually they need to give example themselves by getting involved in research before anybody else. By giving these reports to experts you have better chances for success for good monitoring for integrating research efforts in the whole university. Reviewers can comments that there are few projects for example the greywater in one college, wastewater in another Jabal Alakhddhar initiative which has water element in a third one how can these three projects be complimented by each other.

Another factor is collaboration with implementing authorities, public authorities and private ones because they implement the results not SQU without them SQU would not be able to achieve that part. They also can review our progress reports why not they are more into these issues compared to us their opinions are very vital to our research, reviewing the proposals as well I would say that for big proposals if authorities are not part of the research team the project should not be approved at all. These authorities have the up to date data at least for this element of the project. I would say that again the research centres can do that faculties at colleges not necessarily would be able to and the HoD, deans would not be able to force them to. The other way to do that is by seconding staff to and from authorities, they come to work as RAs or MSc or PhD paid by their authorities just like what we do we second them technicians to work in ministries paid by us that way we can work very closely and then we can create an impact, remember if we think of impact upfront then we can get it in the picture at earlier stages. Every proposal should have its proposed way of transferring the foreseen knowledge to implementation and if not it should not be approved.

Let me tell you about this dilemma, there are people here that they believe they are academics they should not be told what they should do, I'm a professor you should not come and tell me what I am suppose to do, I do what I think is interesting and if you like to implement it then you are most welcome, this one extreme. I propose another extreme which is you are professor and you know what you do but show me what you can do on the ground not on paper in your own field. I think SQU should do the same as industry, until I came to SQU I used to write proposals and win projects to secure my salary, my technician and other staff salaries, the funding agencies which in most of the cases is the industry will tell me I have problems in these areas tell me what you can do about that. Some time I have to strive hard to convince some companies that I can improve their productivity by doing that and that is the way I won projects, but here I propose what I like even if it is something that will benefit my own country but not Oman that is entirely not fair. Recently I wrote a proposal to the desalination plan that we can improve their productivity if we do that and this.

that is the way SQU should operate, at the end this a public money and we should be prepared to answer any questions by authorities related to this issue.

**Q9. *Have you come across a project that was not successful?***

A9. Only if the research has not done anything at all then can be considered a failure. If I know that this research is going to have positive results then that is not research. The research has to have a degree of uncertainty, so negative results are expected. Having said that I think that research projects are failing because they are not being managed properly. Pls never write reports or do not know what his team have done I hear all these and it is pure project management skills. But research cannot fail as it is always educative.

**Q10. *If you to select research projects at SQU what is the criteria that you will use?***

A10. There are two criteria one is attractiveness and second is visibility. Let us say that for water proposal there is attraction i.e. SQU is attracted to this proposal then come the visibility part is it visible for SQU to do it. If not visible you can increase its visibility by hiring experts to do that, but if it is not attracting at all we should not be bothered with at all. There are logic ways of doing it prioritizing it but here these are not implemented because there is no competition, number of proposals are more than available funds.

**Q11. *What would you do with those who would like to work on basic research?***

A11. We need to create a balance which does not need to be in the middle, it could be 80% applied and 20% basic. The problem that not all academics are good in applied research some of them if you put them in an applied research they might fail miserably. The HM project should be given to research centres and the IG funds should be divided into two portions 20% given to basic and 80% to applied research 2 medium size projects each college. That is what I would do if it was to me.

**Q12. *If this distribution is done would make SQU's research successful?***

A12. See, this is only resource allocation it does not assure success, success is something up to individuals. Some people complain about teaching load and working hours but that is not true many researchers teach same number of hours and still have deliver good results and outcomes, this is just an excuse the matter is welling if they well they will do it but as I said why they should when their jobs are secured.