Industrial Firm Technology Transfer:

The Role of Marketing

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Abstract

Reliance on marketing concepts and frameworks that are out of step with practice in a new economy environment presents a particular problem for industrial marketers intent on extracting revenue from firm technology transfer effort, and is a challenge for marketing scholars seeking to bridge the gap between theory and practice. Using an interpretive methodology and the case study method, the study addresses the question *what are the roles that marketing plays in industrial firm technology transfer effort* by comparing and contrasting concepts and themes occurring in marketing and technology management theory with empirical data collected from four large scale industrial firms owned by the New Zealand Government.

Interpretive analysis of marketing phenomena within and across the *Case* firms show that meta-patterns exist across marketing theory and the empirical data, and are also reflected in marketing practice. These meta-patterns reveal a role for marketing in firm technology transfer through deployment of resources that promote inter-firm and intra-firm relationships, collaboration, and cooperation, and the development of firm technological knowledge. The analysis facilitated development of a unique conceptual framework for industrial marketing that accommodates the meta-patterns identified in the study. The conceptual framework is significant because, in addition to providing a guide for industrial marketing practice, it challenges the efficacy of the traditional (4Ps) theory of marketing, which at its core relies on concepts that are not reflected in the

study’s empirical findings, contemporary marketing theory, and contemporary marketing practice.

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I am also indebted to Forest Research (now Scion), NIWA, and the Foundation for Research Science and Technology for employing me during the course of the study. Without this support, completing a PhD would not have been possible.

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CONTENTS

List of Figures

List of Tables

Chapter 1 - INTRODUCTION

'A prudent question is one-half of wisdom' - Francis Bacon

Background to the Study

This study sprang from the author acknowledging that, after twenty years of industrial marketing and general management experience across a range of industry sectors, the concept of marketing appeared to be as disparate as its practical application was misunderstood. It seemed that every organisation had a different view as to what actually constituted 'marketing' and every individual had their own view as to what was (or should be) embodied by the 'marketing concept'[1]. What was especially perplexing, however, was the realisation that despite espousing the benefits of 'market focus' and 'customer orientation', firm prescriptions for marketing's 'role' were invariably a convoluted mix of attitudes, understandings, ideas and experiences.

As a practitioner, this brought stark realisation that before meaningful marketing effort could commence, there was a need to 'market the marketing concept' to individuals and functional groups within the firm. Effectively, this meant that while it was possible to develop carefully researched marketing plans and actions, it was not prudent to assume that individuals understood (let alone

[1] That is, meeting the needs of customers.

embraced) the concept of marketing or that functional groups would engage with the underlying intent and rationale. Indeed for some, ‘meeting customer needs’ was viewed as a nefarious concept that served only to interfere with the business at hand. Failing to get internal market ‘buy-in’ invariably meant a struggle for support and resources to increase firm marketing effort.

The marketer’s inquisitive nature compelled the writer to seek explanation as to why there appeared to be a ‘marketing malaise’ in many of the firms I had dealings with – be it as manufacturer, customer, supplier or distributor. Indeed this dearth of marketing thinking was so prevalent that, perceptibly, it had become normative – manifesting in expressions like ‘marketing is just an overhead’, ‘advertising and marketing are the same thing’, ‘marketing is just smoke and mirrors’, or the perennial, ‘if you have a good product it will sell itself’.

1.0 Marketing Challenge or Challenge for Marketing?

Increasingly I wanted answers to my marketing conundrum. Why was the marketing concept so universally misunderstood and the activities that surrounded it so disparate? How could marketing be seen on one hand as a core business activity, yet on the other, not be easily defined or explained? Why was it that almost all of the very many firms I had been exposed to lacked a cohesive marketing plan[2], let alone one based on detailed knowledge of the customer and the market environment? Why was it that increasing (profitable) sales was considered paramount to firm sustainability – always a core objective - yet paradoxically, developing internal strategies and abilities to achieve external market penetration was often not considered at all? Why was it that there was seldom a clear definition for marketing's role within the firm other than the usual 'stretch' targets for sales and revenue growth?

Even the marketing literature seemed at odds in explaining what actually constituted 'marketing', and by its own admission, was struggling to settle on a definition that adequately elucidated the marketing concept[3]. New domains for marketing were opening up and while academics examined concepts like 'relationship management', 'cooperation' and 'internal marketing', industrial firms were becoming alert to new business opportunities associated with 'knowledge management', 'innovation', and 'technology transfer'. All this seemed to further stymie an adequate definition for marketing, let alone

[2] Or, if there was one, it was 'consigned to a bottom drawer', i.e. not embraced by other firm functions. The reader is invited to consider whether there is an active market plan at work in their own organisation.

[3] See for example Ahmed, Rafiq and Saad, 2003; Gummesson, 2004; Harrison and Shaw, 2004; Holbrook and Hulbert, 2002; Holden, 2004; Nakata, 2002; Rafiq and Ahmed, 2000; Scullin, Fjermestad and Romano, 2004; Varey and Lewis, 1999; Yau , McFetridge, Chow, Lee, Sin and Tse, 2000. Note also, that even the American Marketing Association saw the need to revise its 1985 definition in 2004, and then again in 2008.

illuminate actual marketing practice. For many practitioners, the marketing concept and the practice of marketing had become something akin to the lost city of Atlantis: that is, most knew of its existence, but no one seemed to know how to get there.

1.1 A Changed Business Environment

As if to complicate matters further, the business environment had changed dramatically. Globalisation of markets, burgeoning technology innovation and transfer, and widespread use of the internet, had altered the competitive landscape. In the past industry could rely on supplying the needs of a captive local or regional market; now the new environment meant that offshore companies were able to target the New Zealand market. Local customers that had hitherto only limited opportunity to engage with alternate suppliers now became targets for multi-nationals adept at promoting sophisticated technologies and more cost-effective product, process and service solutions.

This is very significant because, for marketing practitioners, few things have as much impact as a changed business environment. Almost suddenly, the global economy had created a competitive landscape in which markets, competitors and industries were changing constantly and unpredictably, and technology and technological knowledge had become all-pervasive[4]. Indeed even the very notion of what constituted 'value' was coming under increased scrutiny (Lindgreen and Wynstra, 2005; Walters, Halliday and Glaser, 2002).

For the writer, these changes presented a myriad of new issues and challenges for firm marketing effort. Market research[5] showed that the business environment was changing and, perceptibly, many firms were not well positioned to meet the resultant shifts in expectation and demand from customers, suppliers, and networks. Seemingly, new business imperatives were emerging. Firm competitive advantage was increasingly based on managing processes that facilitated innovation activity and the commercialisation of technology and technological knowledge. Now, failing to innovate new technologies and technology products would, as marketing scholar Kotler (2000) succinctly put it, 'expose the organisation to extreme risk and an uncertain future' (p. 289). Perhaps, what was needed was greater marketing involvement in firm technology transfer effort – from idea to inception - as a way to unite

[4] The management literature also reinforces this view. See for example Bean and Robinson, 2002; Harvey and Novicevic, 2001; Lichtenthaler, 2003; Massey, Montoya-Weiss and Holcom, 2001; Matthyssens, Pauwels and Vandenbempt, 2005; Rowley, 1999, 2000; Tapp and Hughes, 2004.

[5] The collection and interpretation of information and knowledge gained from e.g. the media, the internet, pro-active market intelligence gathering and market intelligence from customer and network contacts and relationships.

functional effort, and match firm technical development to market needs. In short, technology transfer - but from the perspective of marketing.

For this study, this is the crux of the matter, for in the new, global and technology-driven business environment, marketing's role in firm technology transfer effort is unclear, and reliance on conventional marketing frameworks (read: the 4Ps) has become less relevant. In this environment *new concepts and frameworks are needed to guide industrial marketing management.*

1.2 The Importance of Technology Transfer in Industrial Marketing

The significance of firm innovation and the development of technology products and services as sources of competitive advantage has become so widely accepted that the processes associated with transferring technology within and between industrial firms has attracted much attention from scholars and practitioners alike (Arias and Acebron, 2001; Bean and Robinson, 2002; Buono, 1997; Lin, Tan and Chang, 2002; Rogers, 1995; Simkin, 2000; Tzokas, Hultink, and Hart, 2004; Zahay, Griffin and Fredericks, 2004). Ready acceptance that technology transfer is critical for wealth creation means that technology development and transfer abilities have become an important strategic asset (Jones and Smith, 1997). Indeed for many industrial organisations, the ability to innovate, develop and transfer technology products and improve existing ones has become their very lifeblood (Drucker, 1993; Frambach, 1993; Lin, Tan and Chang, 2002).

However, despite ready acceptance of the criticality of technology innovation and transfer as a source of competitive advantage and business survival, improving the return on firm investment in technology transfer *continues* to be highly problematic. Marketing practice and management theory both report alarming failure rates, with only one in ten technology product concepts succeeding commercially, and only one in four development projects becoming commercially successful (Cooper, Edgett and Kleinschmidt, 2004).

For industrial firms, the increasing cost and complexity of technology development and a trend toward shortening product life cycles (Phaal, Farrukh and Probert, 2001), low technology transfer success rates (Lewis, 2001), increasing competitive pressure (Kotler, 2000), changing distribution channels (Woodside, 1996) and the globalisation of markets (Hofstede, Wedel and Steenkamp, 2002) ensures a constant struggle to achieve satisfactory performance from technology transfer effort. Couple this with the high cost to develop, promote and commercialise new technologies, firm resource constraints, competitive pressure and a need to demonstrate return on R&D investment, and effort in determining marketing's role in firm technology transfer presents a *key marketing opportunity* - one that strikes at the heart of firm business survival.

For the marketer, firm business survival and competitive market advantage underpin marketing effort. The difference now is that the business environment suggests a need for firm ability to deliver quickly and globally a variety of customised technology products and services - ideally with customer and network involvement in the innovation process. This is of significance to this study because, in theory, firm technology innovation, development, and transfer require, by their nature, firm engagement with the internal market (innovation and development) and the external market (transfer and diffusion), and marketing is well placed to facilitate this engagement. Therefore an understanding of marketing's role in firm technology transfer has itself become a critical requirement.

Research Objectives

In essence, the objective of the study is to explore industrial marketing in today's business environment. The primary goal is exploration and description of marketing's theoretical role in firm technology transfer effort. In a practical sense, the intent is to highlight the opportunity that marketing presents to firms seeking to innovate and transfer technology products and services for market advantage. Thus, in addition to marketing theory development, the study aims to develop practical insights for marketing's 'role' in firm technology transfer – *but from the perspective of marketing*.

The question the study addresses is:

What are the roles that marketing plays in industrial firm technology transfer effort?

Three tactics are employed to meet the research objectives. Firstly, the literatures of both ‘marketing’ and ‘technology management’ are reviewed to ensure that conceptual development of marketing’s role in firm technology transfer effort is informed by technology management theory, enabling the researcher to more precisely address the research question. Further, because the research took place within the context of contemporary industrial R&D, the literature review places particular emphasis on contemporary industrial marketing theory.

The second tactic involves selection of a methodology and method that enable exploration of the complexities and variability of industrial marketing, and the difficulties associated with firm technology transfer effort. It also reflects the researcher’s desire to accommodate the individual (human agency) perspective *and* the firm (social structure) perspective. To this end, the study adopted a qualitative approach to data collection and analysis, using the case study method to allow sufficient depth of enquiry into the phenomena associated with marketing and firm technology transfer. The methodology and methods adopted by the study are more fully explained in Chapter Three.

The third tactic relates to the study's intent to develop a more holistic understanding of marketing's role in firm technology transfer effort by combining perspectives in marketing theory with phenomena from the research setting, and with the researcher's reflexive position as an industrial marketer. An objective here was to close the gap between marketing theory and practice by conceptualising and developing a theoretical role for marketing that is informed by theory and practice.

1.3 Research Scope

The scope of the study encompasses firm marketing management *and* firm technology management in the context of New Zealand industry. It is concerned with developing a theoretical role for marketing in the total technology transfer process, with a particular focus on marketing activities and processes that contribute to firm technology transfer outcomes.

Specifically, the scope of the study encompasses:

1. The technology innovation, development, transfer and diffusion activities and processes occurring in the context of four Government owned Crown Research Institutes involved in developing and transferring technology products and services for market advantage.

2. The marketing activities and processes associated with firm technology development and transfer effort in the context of four New Zealand Crown Research Institutes.

Structure of the Thesis

Where Chapter One introduces the practical and theoretical conundrum facing industrial marketing in the new economy and introduces the challenge facing firms seeking to transfer technology, Chapter Two examines the literature that pertains to technology innovation, development, transfer and diffusion, together with examination of the literature that underpins marketing's role in firm technology transfer effort. In this chapter, two aspects are of particular interest. The first relates to a focus on concepts from marketing theory that are associated with the new 'networked' economy, in particular 'technology transfer', 'knowledge', and 'relationships'. The second aspect relates to the intent of the study to accommodate a range of marketing 'perspectives' as a way to more holistically explore and interpret marketing's role in the technology transfer process. This inductive approach more fully explained in Chapter Two, uses a number of theoretical perspectives to develop literature themes and, concomitantly, assisted with choice of a theoretical perspective to guide analysis.

Chapter Three explains and justifies the methodological approach adopted by the study, the underpinning theory behind the choice of the interpretive approach, the case study method and the role of thematic and pattern analysis in the research process. A discussion of each method, incorporating the strengths and weaknesses associated with each, is also presented.

Chapter Four provides a historical context to the CRI *Case*, describes each *Case* firm, and initiates a contextual review of the activities and practices that relate to technology innovation, development, and transfer effort. The chapter also begins the interpretation of marketing's role in *Case* technology transfer effort.

The focus of Chapters Five and Six is to present an analysis of the themes and concepts induced from the empirical data and inferred from theory so that marketing's role in technology transfer could be illuminated and conceptualised. Chapter Five describes and analyses the activities and processes related to technology development and transfer processes *within* the context of each *Case* firm, whereas Chapter Six analyses and interprets the various roles that marketing plays in technology transfer *across* the *Case*, with special attention given to comparing across-*Case* marketing patterns with marketing patterns in theory and practice.

Where Chapter Five and Chapter Six contain the key findings from the data analysis, the purpose of Chapter Seven is to summarise and discuss the key findings and conclusions, and to examine the study's claim to meeting the research objectives. The chapter also presents a new conceptual framework for marketing's role in firm technology transfer effort, and concludes with an exploration of managerial implications, policy implications and suggestions for further research.

To place the literature review in context, and to demonstrate the study's intent to 'improve the relationship' between marketing theory and practice, two 'road maps' are presented. The first, Figure 1-1, outlines the research process and the study's relationship to themes, concepts, and categories that are occurring in marketing theory and in marketing practice. The second, Figure 1-2, focuses on the study's theory development process by presenting an overview of the themes and patterns that were identified in the empirical data, in marketing and technology management theory, and in marketing practice.

Figure 1-1: Exploring Marketing's Role in Industrial Firm Technology Transfer: overview of the research process

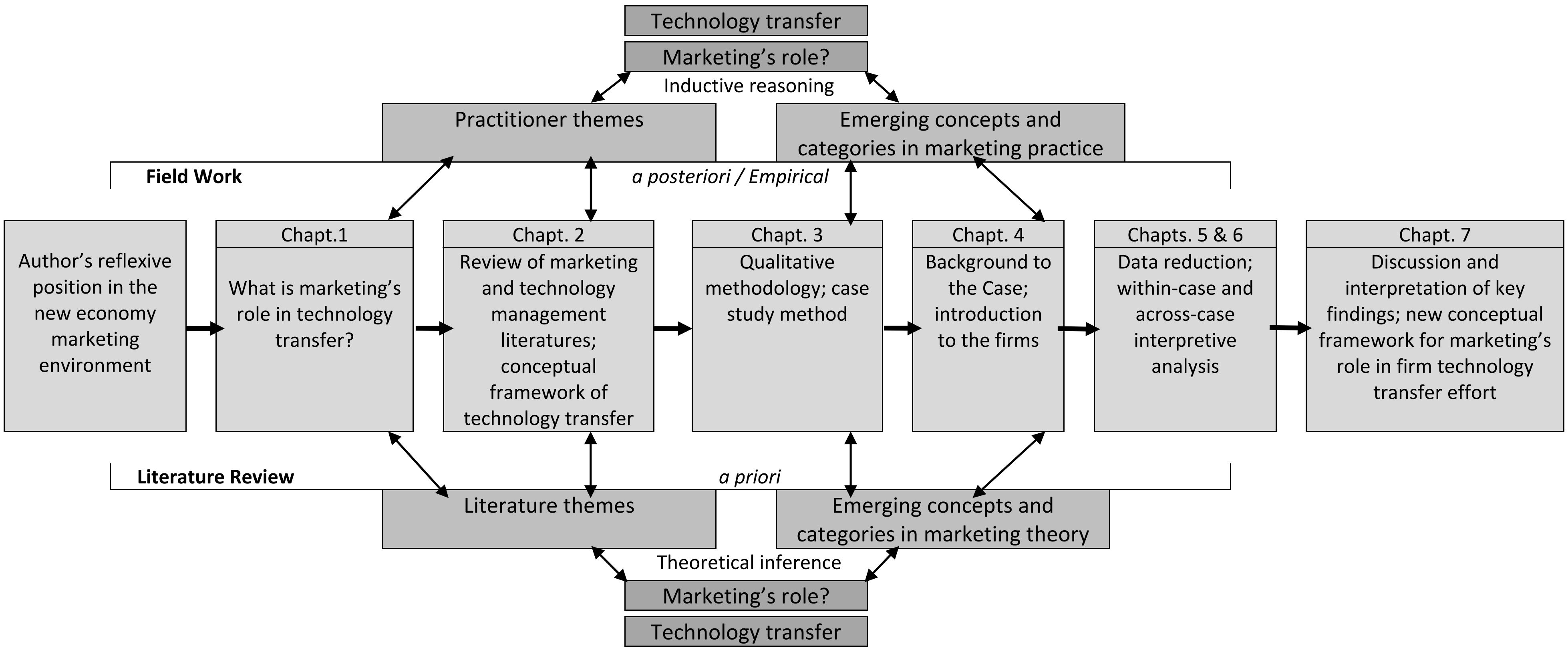
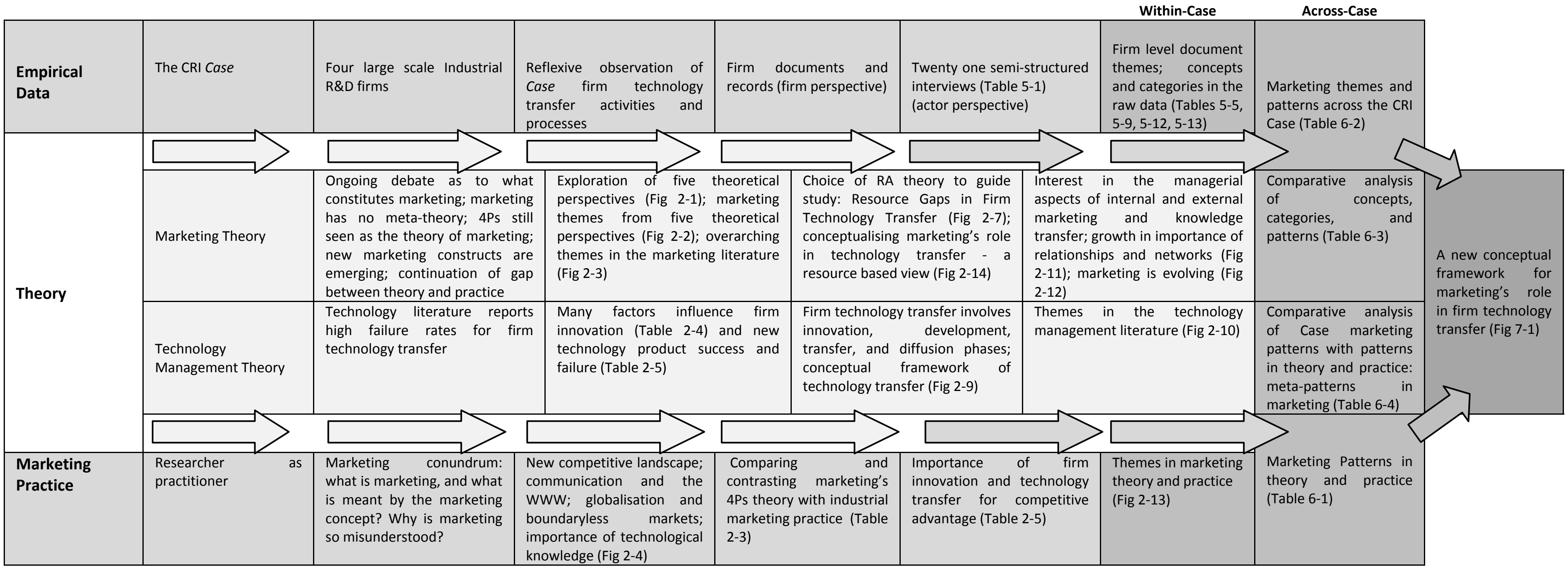


Figure 1-2: Exploring Marketing's Role in Technology Transfer: overview of the theory development process



Chapter 2 - LITERATURE REVIEW

'If everyone is thinking alike, then somebody isn't thinking' - George S. Patton

Introduction

In a practical sense, the starting point for this thesis sprang from realisation that answering pointed questions like *what constitutes marketing, what is marketing's domain, and who is responsible for marketing* continued to prove a difficult task. This apparent conundrum for marketer's and for firm marketing effort goes to the heart of this study. Why does the concept of marketing, and its practical application in industrial firms, continue to be misunderstood despite decades of marketing practice and theory development? Why do industrial firms, intent on extracting revenue from technology transfer effort, continue to report failure rates that exceed 90 per cent?

Literature Review Strategy

Three key drivers underpin the review strategy. Uppermost was the desire to review the literature that examined marketing's *theoretical* role in a business environment that reflects widespread use of the internet, technology innovation, and global competitive pressure. Therefore emphasis was placed on literature published after 1995 that encapsulated the more contemporary constructs of 'technology transfer', 'relationships' and 'knowledge'. In so doing, it was hoped that the author's reflexive position would provide an opportunity to compare and contrast contemporary marketing theory with contemporary marketing practice.

The second key driver, itself a reflection of the current business environment, concerned a desire to examine the literature on technology management – from idea to adoption - *and its relationship to evolving marketing theory and practice*. Given the well documented and increasing importance of technology innovation and new product development as a source of competitive advantage, it was reasoned that examination of both literatures gave the best chance to develop industrial marketing theory.

The third key driver reflected the author's intent that the review had both a sound academic basis and added value to marketing managers and practitioners. It was reasoned that, while academics and practitioners lament the gap between actual practice and its theoretical cousin, it was generally from the perspective that theory was somehow 'out of touch' with practical reality. However, it is the author's assertion that practitioners would do well to examine the 'marketing opportunity' that is theory so as to better inform marketing practice. Thus, it is hoped that, as a contribution, the thesis is able to close the gap between marketing theory *and* marketing practice.

(i) *Scope of the Literature Review*

As previously stated, the central concern of the study is the exploration and conceptualisation of marketing's role(s) in a business environment where innovation and technology transfer have become critical for firm prosperity. While the review focuses on contemporary marketing theory and its inter-relationship with technology management theory, it is asserted that the 'role' marketing plays - or could play – in firm technology transfer is not clear in theory or in practice. The review thus has a basis in marketing and technology management theory *and* practice. In this regard, the review scope presented in Table 2-1 below utilises constructs from marketing and technology management theory *and* practitioner experience as a guide.

	Theoretical Constructs	Literature Focus	Practitioner Aspects	What are the roles that marketing plays in industrial firm technology transfer effort?
Internal Market	Concept of Marketing	Contemporary Marketing Theory and Technology Management Theory	Contemporary Marketing Practice	
	Internal Market	Internal Marketing	Internal Market Development	
	Technology Innovation & Development	Innovation & Technology Development; R&D; NPD; Stage-Gating	New Products, Competitive Advantage; Sales Management	
	Cross-Functionality	Relationships, Teamwork & Co-Operation	Firm Competence Development	
	Knowledge as an Asset	Firm Technological Knowledge	Technological Knowledge for Competitive Advantage	
External Market	New Economy	Globalisation and the Internet	Changed Marketing Environment	
	External Market	External Marketing & the 4Ps	Network & Customer Intelligence	
	Technology Transfer	Technology Commercialisation and Diffusion	Technology Marketing	
	Customers; Value Chains; Networks	Customer & Network Relationships	Relationship Management	
	Customer Orientation	Marketing Service Provision	Value Proposition Development	

Table 2-1: Literature Review Scope

(ii) *Organisation of the Literature Review*

Two overarching themes continue to express themselves in the marketing literature, each integral to addressing the research question. The first relates to the ongoing debate as to what actually constitutes marketing, what is meant by the marketing concept, and division between marketing theory and practice. The second theme relates to the changed market(ing) environment from within which a steady stream of scholarly researchers remonstrate over globalisation and the resultant boundaryless markets, sectors, industries, networks and value chains; the rise of the internet, innovation and technology transfer; and relationships and knowledge as a (new) means to competitive advantage. As has been noted, few things impact a marketing manager quite like change in the marketing environment.

In essence the review attempts to bring together the practice and theory of industrial marketing within the context of the 'new economy' business environment. It is suggested that by comparing and contrasting marketing theory with practice, and then with the empirical data, it is possible to illuminate and interpret marketing's role in firm technology transfer effort.

(iii) *Structure of the Review:*

If it can be argued that a weakness of marketing theory has been to stay within 'outmoded frameworks' (Bean and Robinson, 2002), then synthesising the contemporary marketing and technology management literatures permits exploration of the various roles that marketing plays in industrial organisations and the activities and processes that contribute to technology transfer outcomes. Importantly, it also illuminates the ‘mix’ of theoretical perspectives used by marketing scholars to conceptualise and promote the marketing concept.

Hence, the first section of the review explores a number of theoretical lenses in marketing theory to focus and develop literature themes, and to assist with selection of a theoretical perspective from which to address the research question. It is suggested that exploring multiple theoretical lenses during the review process heightened the ability of the study to conceptualise marketing’s role and promotes the generalisability of the developing literature themes. Section One concludes with justification for the selection of Resource Advantage (RA) as a theoretical lens appropriate for analysing the case data.

Section Two examines the marketing literature and expands on the two overarching themes that emerged during the early stages of the review. Each of these themes and sub-themes, and their connection to evolving marketing theory and contemporary marketing practice are discussed in turn. The second section also discusses the technology management literature and its relationship to marketing theory and practice. Here, innovation and technology management theories are explored and a conceptual framework for technology transfer is developed to enable interpretation of marketing’s role in firm technology transfer effort.

The expanded literature themes pertain to:

1. Evolution and revolution in marketing theory and practice and debate as to what actually constitutes marketing
2. The changed marketing environment and the impact of globalisation and the internet
3. Technology transfer and the marketing of technology products
4. The rise of knowledge as a source of competitive advantage
5. The evolution of business-to-business relationship management and the move toward a service dominant view of marketing.

Section Three focuses and develops the themes and the sub-themes that emerged during the review process. Here, marketing and technology management theory is compared and contrasted with industrial marketing practice to better enable conceptual development of marketing’s role in firm technology transfer effort.

Section One: Theoretical Perspectives in the Marketing Literature

As introduced above, a number of perspectives in marketing theory were explored during the review process. While not exhaustive, these perspectives were identified as lenses through which it was possible to examine and interpret marketing's role in technology transfer. In effect, the intent was to coalesce theories of 'human agency' with 'social structure' and so doing, accommodate the apparent duality of these theoretical positions and their interrelationships. In this way, the consideration of "alternate routes of interpretation and analysis is better accomplished through familiarity with a span of theories and vocabularies" (Alvesson and Deetz, 2000, p. 116).

Further, it was considered that this approach enhanced the efficacy of the review given that it did not discount any particular ontological or epistemological view of marketing, and so doing had greater propensity to reflect the multiple relationships, networks, activities, and processes associated with marketing's involvement in firm technology transfer. It also provided an opportunity to interpretively develop a suitable theoretical position from which to examine the empirical data and address the research question. In this regard, resource advantage theory was selected as an appropriate perspective, with its usefulness to the study discussed at the end of this section.

The theoretical perspectives explored during the review process are identified in Figure 2-1:

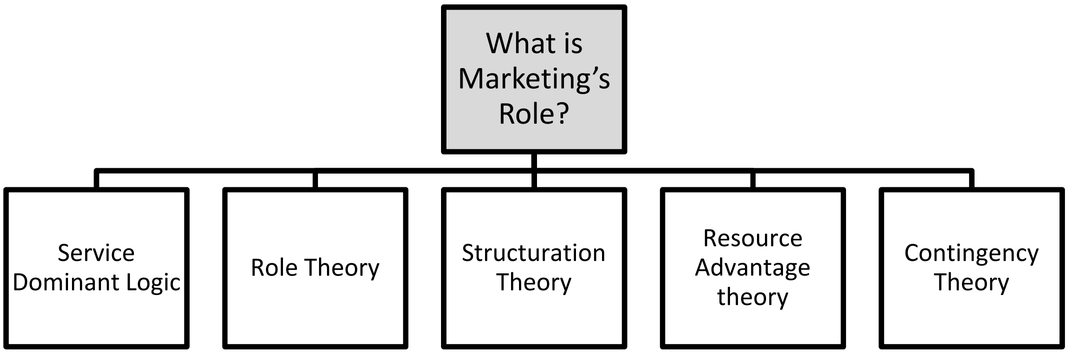


Figure 2-1: Theoretical Perspectives in the Marketing literature

In order to determine their relevance to the study, each theoretical perspective is briefly discussed below. The intent was to begin interpretation of marketing's role in technology transfer using each lens to develop themes across marketing theory.

2.1 Structuration Theory

Structuration, as conceived by its original proponent Anthony Giddens, is a process-based theory that attempts to reconcile both macro and micro levels of analysis. In effect, it tries to supersede, rather than resolve, the two dominant approaches of social thought – functionalism and interpretivism (Giddens, 1984). For Taylor, Groleau, Heaton and Van Every (2001) structuration theory centers its attention on human activity and treats concepts such as 'organisation' and 'technology transfer' as derived from a 'focussed world of practical action'. For Taylor et al. such concepts can be framed in terms of 'activities and practices' rather than 'cause and effect'. This is important to this study because it is contended that marketing and technology transfer are best understood as dynamic and ongoing processes during which 'actions and institutional structures are inextricably linked' (Edwards, 2000).

Where 'structures' have traditionally been seen as the formal and informal links of organisational activities and elements, when viewed through structuration theory lens, structures are 'codes of behaviour and implicit stores of knowledge that exist in workers' heads', that 'steer individual and collective organisational action' (Giddens, 1984). For Lewis and Suchan (2003) these 'structures' are described as 'mental blueprints' for action within specific organisational contexts and cite, as examples, knowledge exchange with co-workers, customers or suppliers, or assessments of how suppliers and customers will use new technologies. A conclusion here is that, when seen through the structuration lens, marketing's role can be conceptualised as involving individuals, groups, or organisations; or as systems with observable patterns of relationships and communicative interaction. In this way, systems and structures exist in a dual relationship with each other, tending to produce and reproduce each other in an ongoing cycle.

2.2 Role Theory

Within the marketing literature, role theory has formed an important strand in the understanding of business-to-business relationships (Broderick, 1999). Indeed the rise in the importance of relationship management within the marketing dialogue has seen role theory being utilised to examine, for example, aspects of relationship intensity and quality and customer retention. The relevance of role theory to marketing research also manifests as a particular focus on social exchange within marketing encounters, bringing with it an inherent theoretical ability for application across 'widely different contexts, dyadic social exchanges and multi-person interactions' (Blau, 1968; Homans, 1961). This ability is further reinforced by Lusch, Brown and Brunswick (1992) who argue that, in addition to offering a 'dyadic focus', role theory is 'linked to both internal and external concepts of marketing exchange'. Again, for Burns (1992), focusing role theory on marketing encounters promotes deeper understanding of the behavioural and relational elements of marketing exchange through 'interpretation of the interactions taking place within these social exchanges'. A conclusion here is that, when seen through the role theory lens, marketing's role can be conceptualised as extending the understanding of the behavioural and relational elements that are associated with technology transfer, with managing interactions and inter-dependencies, rather than focussing on actions, contributing to successful marketing encounters.

2.3 Resource Advantage Theory

Resource-advantage (RA) theory is an interdisciplinary theory that has been developed in the literatures of marketing (Falkenburg, 2000; Hunt and Duhan, 2002c), management (Hunt, 1995), economics (Hunt, 1997b), and general business (Hunt and Duhan, 2002). For its proponents, RA theory is an evolutionary theory of competition that holds as a foundational premise that the primary objective of the organisation is 'superior financial performance'. At its core, 'RA theory combines heterogeneous demand theory with the resource-based theory of the firm' (Hunt, 2001). Here intra-industry demand and preferences are seen as significantly heterogeneous and therefore require different market offerings for market sectors within the same industry. In effect, both the organisation's resources and its markets are in a constant state of flux, echoing the reality for many marketing practitioners. A conclusion here is that, when seen through the RA lens, marketing can be conceptualised as managing dynamic resources that include, for example, the firm's finance, plant and equipment, technical capability, internal and external relationships, market intelligence, and technical knowledge.

2.4 Contingency Theory

The basic proposition of contingency theory is that organisational viability is contingent upon a fit between organisation and environment. This perspective, now referred to as the ‘contingency approach’, emphasises the importance of situational influences on the management of organisations and questions the existence of a single, best way to manage or organise. Contingency approaches are positioned within management as mid-range theories between the two extreme ontological views which state either ‘that universal principles of organisation and management exist’ or that ‘each organisation is unique and each situation must be analysed separately’ (Zeithaml, Varadarajan and Zeithaml, 1988).

Because the theory remains a dominant approach to organisation design, it is a widely utilised theoretical approach in the study of organisations (Lawrence, 1993). In this context, the challenge for marketing is one of identifying structural designs (i.e. activities and processes) which are ‘efficient, effective and viable under conditions of a changing marketing environment’ (Burton and Obel, 1998) and that accommodate organisational and sub-organisational levels of analysis (Keck and Tushman, 1993). A conclusion here is that, when seen through the contingency lens, marketing’s role can be conceptualised as influencing the design of the firm so that innovation and technology transfer effort is constantly being ‘matched’ to the changing needs of the firm’s internal and external market environment.

2.5 Service Dominant Logic

Since its inception as a management discipline, marketing purportedly 'inherited' a model of exchange from economics which was essentially based on the exchange of manufactured "goods" with a focus on tangible resources, embedded value, and transactions. More recently, new perspectives have emerged that challenge the so called 'dominant' view of economic exchange, focussing instead on 'intangible resources, the co-creation of value, and relationships' (Vargo and Lusch, 2004, p.1). It is from within this context that service dominant (SD) logic emerged, with its central tenet being "service provision rather than goods are fundamental to economic exchange" (p.1). Essentially, this 'service centred' view of marketing implies that marketing is a continuous series of social and economic processes that are largely focused on 'operant' (read: knowledge and skills) resources with which the company is constantly striving to make better value propositions than its competitors. Because firms can always do better at serving customers and improving financial performance, 'the service-centered view of marketing perceives marketing as a continuous learning process' (Vargo et al., 2004, p.5). A conclusion here is that, when seen through the lens of SD logic, marketing's role can be conceptualised as facilitating services that place emphasis on the intangible nature of inter and intra-firm relationships and exchange processes.

2.6 Summary and Conclusion

In essence, the study adopted a strategy that juxtaposed a number of theoretical lenses during the early stages of the review so that a range of marketing perspectives of could be conceptualised and marketing themes common to each perspective developed. These themes are shown in Figure 2-2, below.

As could be expected, given the focus on contemporary scholarship, the themes of ‘change’ and ‘dynamism’ are pervasive across each of the theoretical perspectives - matching the practitioner marketing environment. Changes in structures and systems (structuration), changes in the types of social exchanges and inter-dependencies (role and SD), dynamism in customer and supplier networks and industries (RA and contingency), changes in the way firm value is defined and created, and an evolution in the way that firm resources are conceptualised and deployed (SD and RA).

From a *firm* perspective, this theoretical dynamism in marketing theory manifests as a transformation of systems, structures, resources, relationships, networks and value creation processes. Whereas, from the *individual* perspective, dynamism is typified by increasingly inter-dependant relationships both within and outside of the firm, with the application of technological knowledge (resources) - rather than production outputs – being central to firm technology transfer effort. A conclusion here is that contemporary marketing scholarship - whatever the theoretical perspective - reports an evolution in the way that the marketing environment is conceptualised. In this environment, new and important marketing constructs are emerging - in particular those of ‘knowledge’ and ‘relationships’. This is important for marketers, ipso facto the intent of the thesis to explore and interpret marketing’s role in firm technology transfer effort. Given scholarly acknowledgement of environmental and technological change, and themes in the marketing literature suggesting that marketing’s normative (4Ps) role may be somewhat outmoded, then perceptibly, there is a need to re-conceptualise marketing and its role in firm technology transfer effort. This is the purpose of the study.

Figure 2-2: Marketing Themes from Five Theoretical Perspectives

2.7 The Choice of Resource Advantage Theory as an Analysis Framework

As previously stated, the theoretical perspectives utilised during the course of the literature review assisted the development of marketing themes, and together with the author's reflexive position, enabled the study to consider the multiple relationships, networks, activities and processes associated with ‘marketing’ and ‘technology transfer’ effort.

At the completion of the review, and with the benefit of hindsight, the researcher then determined that resource advantage (RA) theory was a theoretical lens appropriate for analysing the empirical data. It was considered that while each of the lenses provided useful perspectives from which to review marketing theory and inform the study, RA theory[6] was the most suitable perspective given that it could, in theory, transcend ‘human agency’ and ‘social structure’, account for change in the marketing environment, and accommodate the emerging literature concepts of ‘co-operation’, ‘relationships’, and ‘technological knowledge’.

In general, there is agreement that the central focus of RA theory is the exploitation of resources to gain sustainable competitive advantage, although there is some debate as to what constitutes a firm ‘resource’ given the ‘plethora of conceptual definitions in the extant literature’ (Galbreath, 2005). The review revealed two categories of ‘resources’ that are distinguished in RA theory: (i) tangible resources – characterised as containing financial or physical value as

[6] Resource advantage theory is also referred to in the literature as the Resource Based View (RBV).

measured by the firm's balance sheet; and (ii) intangible resources – characterised as non-physical in nature and rarely included in the firm's balance sheet. Resources are thus viewed as tangible and intangible 'assets' available to the firm that enable it to produce a market offering that has value for a particular customer or market segment.

Acknowledging the lack of a standardised definition for resources, in this study 'resources' are viewed as factors that have the potential to contribute economic benefit to the firm. Here the application of RA theory views resources as 'assets, capabilities, organisational processes, firm attributes, information, and knowledge that enable the firm to conceive of and implement strategies that improve efficiency and effectiveness' (Barney, 1991).

RA theory further suggests that great importance can be ascribed to the firm's technological capability (Galende, 2006). In this context, firm innovative capability does not come from exploiting externally sourced technologies, which are easily accessible for competitors and therefore insufficient for sustaining a competitive advantage (Barney, 1991, p. 10). Rather, it comes from the generation of *internal* innovation and technology development capability (i.e. technical and marketing activities and processes associated with cross-functional technology development), which implies that the firm's internal market possesses heterogeneous technological resources and the capability to generate other new resources (Fredericks, 2005). Similarly, RA theory suggests that the firm's external relationships and cooperative arrangements also represent firm-specific resources, and as with 'internal resources', can similarly determine the firm's economic performance. For example, specific and detailed technological knowledge relating to network or customer needs provides the firm with opportunities to develop collaborative technology value propositions that meet the identified needs. Proponents of RA theory conclude that strong alliance performance can create 'synergistic benefits' that no other combination of organisations can match with the pooling and utilisation of valuable resources, leading for superior performance for the entities concerned. Thus, when the firm has 'relational' resources that are heterogeneous, specific, and difficult to replicate, the firm is able to create more value for its customers than its competitive equivalents (Barney, 1991; Yasuda, 2005).

In RA theory then, resources are tangible and intangible entities available to the firm that enable it to produce efficiently and/or effectively a market offering of value to a customer or market segment. Resources are viewed as anything that has an 'enabling capacity' (Panayides and Gray, 1999). This includes core competencies that enable a firm to perform its activities better than its competitors (Prahalad and Hamel, 1990), informational resources such as knowledge about customers and competitors (Barney 1991), and relational resources such as relationships with customers, suppliers and competitors (Hunt, 1997a). Given the importance of technological and relational 'resources' in this study, it is therefore significant that some scholars argue that only those resources that are intangible in nature can offer sustainable economic benefit. This perspective is important because as Fitz-enz (2000) argues, "people, not cash buildings or equipment, are the critical differentiators of a business enterprise" (p.1), implying that intangible resources are the key to business success.

The knowledge based view (KBV) is another perspective that has gained support during the 1990's (e.g. Connor, 1991; Baden Fuller Grant and, 1995), its rise coinciding with the advent of the knowledge economy occurring at the same time. Central to KBV are mechanisms for the creation, protection and transfer of knowledge. Kogut and Zander (1996) highlight this perspective by stating "that a firm should be understood as a social community specialising in the speed and efficiency in the creation and transfer of knowledge" (p.503). Thus KBV posits that the firm's knowledge or know-how is now a basis for competitive advantage (Grant, 1996), and differs from RA theory only in that *knowledge is the resource*. Further, like RA theory, competitive advantage within the KBV is based on resource heterogeneity, being difficult to imitate because of the lengthy and difficult processes involved in the creation and application of knowledge resources (Droge, Claycombe, and Germain, 2003).

Table 2-2 presents a summary of intangible resources identified during the review process.

	Intangible Resource:	Source
Internal Market	Firm cross-functional relationships	Fredericks (2005)
	Firm innovation processes	Hult and Ketchen (2001); Carmeli (2001)
	Firm technology transfer processes	Barney (1991); Dierickx and Cool, 1989)
	Firm technological knowledge	Foss (1996);
	Market intelligence	Lambert and Cooper (2000)
	Employee know-how (capability)	Hall (1992); Day (1994)
	Customer relationships	Hunt, Arnett, and Madhavaram (2006); Vargo and Lusch (2004)
	Network relationships	Lorenzoni and Lipparini (1999)
	Intellectual property	Hall 1992
	Reputational assets	Roberts and Dowling (2002)
External Market	Inter-firm cooperative arrangements	Fredericks (2005); Miotti and Sachwald (2003)
	Inter-firm relationships	Das and Teng (2000)
	Inter-firm alliances	Dyer, Kale, & Singh (2001)

Table 2-2: Sources of Intangible Resources for Firms

In sum, RA theory offered the study potential to gain insights into the process of technology transfer, particularly if ideas generation, technical innovation, and the collaborative development of technological knowledge can be seen as marketing resources for firm technology transfer effort. Importantly, the theory also permits conceptualisations of marketing's role in the technology transfer process by taking account of the 'firm' and 'individual' perspectives and the complex and interconnected nature of relationships, networks, and technological knowledge, offering the potential for new and compelling insights for marketing theory and practice.

Section Two: Review of the Marketing and Technology Literatures

As was highlighted in the introduction, five overarching themes emerged during the literature review, with each theme pointing to a challenge for marketing practice *and* for marketing's conceptual development. These five themes are identified in Figure 2-3. The purpose of Section Two is to discuss each of these themes in turn and begin illumination of marketing's theoretical role in firm technology transfer effort.

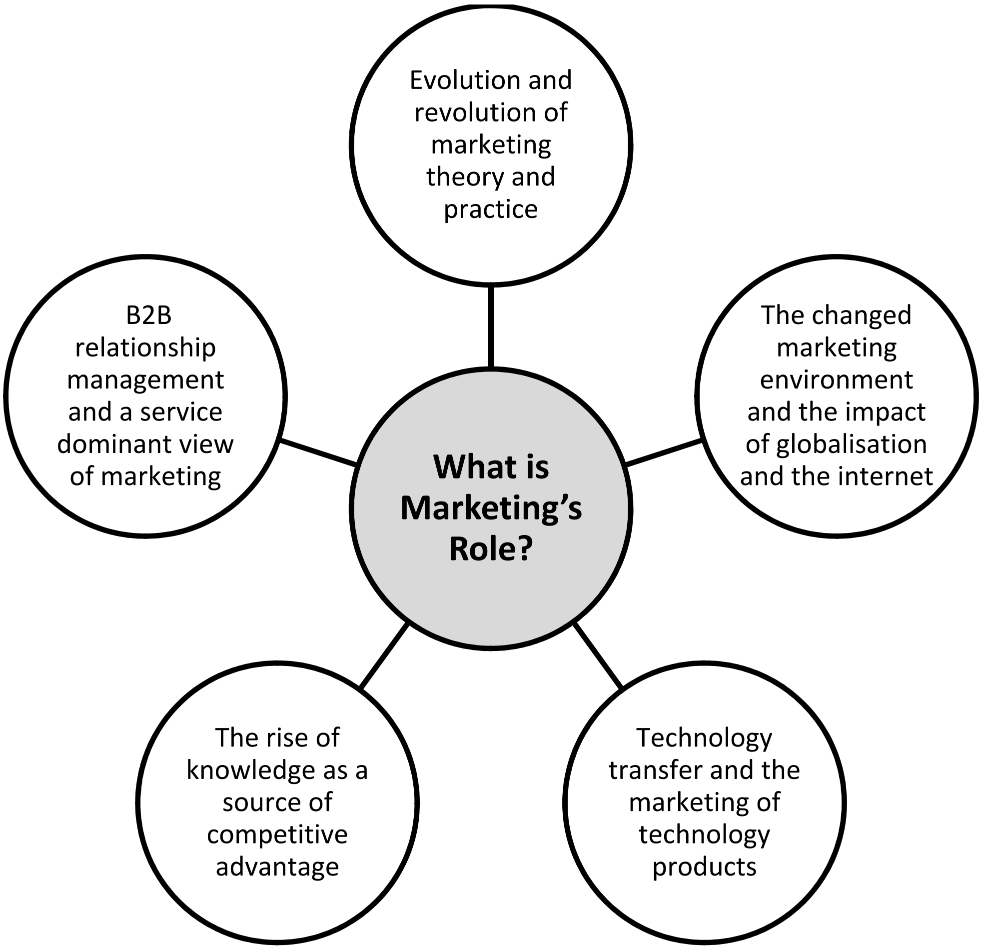


Figure 2-3: Overarching Themes in the Marketing Literature

Theme One: The Evolution and Revolution in Marketing Theory and Practice

While the German school of economics is considered the source of the philosophical foundation of the marketing discipline (Jones and Monieson, 1990), the start of marketing's quest for recognition as a 'science' and its quest for 'law-like generalizations that are empirically testable' (Hunt, 1983) began after World War II. This 'boom' period in business brought with it a 'focus' on managerial marketing, emphasising the desired control of individual consumptive behavior (Mentzer and Schumann, 2006).

Marketing scholars of this period borrowed heavily from the social sciences to include economics, communications, sociology and anthropology, and marketing research methods began to emphasize quantitative tools. However, all was not well with marketing. By the 1970s, a clear separation was occurring between marketing managers and marketing researchers (Mentzer et al., 2006). In 1977, the American Marketing Association (AMA) and the Marketing Science Institute convened a commission to evaluate the effectiveness of research on the development of marketing practice, with members of this commission concluding that research in the discipline "has had relatively little impact on improving marketing management practice" (Myers, Massy and Greyser, 1980, p.280). During this time other marketing scholars remonstrated over the lack of theory development and the gap between theory and its practical application. In his often cited article "The Identity Crisis in Marketing", Robert Bartels (1974) claimed that the concept of marketing had undergone 'many changes' since its inception in the early 20th century and that the literature had become "increasingly esoteric, abstract, and unintelligible to many business practitioners" (p. 76).

The AMA Task Force continued to consider the development of "marketing thought", and in 1988 submitted six position papers, with a summary paper appearing in the October issue of the *Journal of Marketing*. The group, composed of nine academics and two practitioners, was charged with assessing the appropriateness of how the marketing discipline "develops, distributes and utilizes marketing knowledge, with particular attention to the knowledge that emanates from academic theory and research" (AMA Task Force, 1985, p. 2). The conclusion of the group was that the dissemination of academically driven knowledge in marketing practice was "weak at best".

2.8 The Rise (and fall) of Marketing's 4Ps

Despite the view that marketing theory was not finding its way into practice, very few practitioners are unaware of marketing's 4Ps, a framework originally conceptualised by Borden in the late 1950's (Borden, 1964). Indeed, in most marketing textbooks the marketing mix paradigm and the '4Ps' of product, price, promotion, and place are still considered the theory of marketing. Grönroos (1997) argues that this is 'still the case in much of the academic research into marketing, especially in North America but also to a considerable extent in other parts of the world'. Eventually the 4Ps became an indisputable paradigm in marketing academic research, the 'validity of which was taken for granted' (Gronroos, 1997). However, since the 1960s, alternative theories of marketing that were not based on the 4Ps and were largely independent of the standard microeconomic paradigm had emerged. As Möller (1992) observed:

> "…from the functional view of marketing 'mix' management, our focus has extended to the strategic role of marketing, aspects of service marketing, political dimensions of channel management, interactions in industrial networks; to mention just a few evolving trends" (p. 197).

Other lines of thought, perhaps driven by marketing's failure to account for the 'unpredictable nature of human behaviour' (Zinkham and Hirschheim, 1992), surfaced in relationship marketing, knowledge management, technology marketing, quality management, market orientation, value and supply chain management, resource management and new networks. In the early 1990s, Webster (1992, p.1) argued "the historical marketing management function, based on the microeconomic maximisation paradigm, must be critically examined for its relevance to marketing theory and practice". Day and Montgomery (1999) and Kotler (2000) have also signalled their reservation as to the validity and usefulness of the 4Ps concept, arguing that a paradigm shift in marketing was imminent. Even Porter's (1980) well received classification of business strategy into three generic types - 'overall cost leadership', 'differentiation' and 'focus' - came into question, with Treacy and Wiersema (1995) alternatively proposing that firms pursue either 'operational excellence', 'innovation', or 'customer intimacy' as a means to competitive advantage.

Questioning the validity of the 4Ps has not been confined to theorists. For the marketing practitioner, reliance on the 4Ps, at least in a normative sense, has become an increasingly challenging exercise. ‘Products’ have come to mean ‘solutions’ and ‘technological ability’; ‘price’ is no longer calculated by adding a margin to costs - but increasingly reflects other forms of ‘value’ exchange as a result of joint ventures, technology alliances, cross licensing and other cooperative arrangements. Similarly, ‘promotion’ of firm products and services has a new dimension. The internet now allows engagement with customers and suppliers through the firm’s web-site at anytime, and the idea of ‘place’ has become increasingly irrelevant since the distribution of innovations and technological knowledge is now able to be effected in a global context. The increasing inconsistency between the theory and practical application of marketing’s 4Ps is illustrated in Table 2-3:

4Ps	Old Theory	New Practice
Product	• Reliance on physical assets and diminishing returns to scale (Sheth and Sisodia, 1999) • Long product life-cycles (Herbig, Milewicz, and Gulbro, 1994) • Product-based strategies (Lee and Hong, 2002) • Resistance to innovation (Woodside, 1996) • Minimal customer	• Understanding and leveraging technology and knowledge assets are critical factors in gaining competitive advantage • Multiple technologies can be embedded in the product offer • Increasing attention given to the impact of innovation and technology development on the supply chain

4Ps	Old Theory	New Practice
	involvement in product development (Meldrum, 1995)	• Product strategy is giving way to innovation potential and technology transfer ability • High levels of customer involvement in the innovation development and technology transfer processes
Price	• Pricing reflects localised competitive offer (Kotler, 1986) • Pricing reflects fixed and variable costs (Everaert and Bruggerman, 2002) • Pricing reflects involvement of distribution channels (Kotler and Levy, 1972)	• Price has become just a 'part' of a wider value proposition to the customer • Pricing increasingly reflects collaborative involvement with technology partners and other third party relationships • Pricing increasingly reflects emphasis on the 'service' component • Pricing and margins are influenced by the perceived impact of the technology on the customer's customer *and* the supply chain
Promotion	• Business networks are clearly delineated and external (Keith, 1960) • Well defined homogenous markets (Hunt, 1983)	• Increasing industry and sector market diversity and blurring industry boundaries make targeted promotional activities difficult • The internet now allows relatively low cost direct selling to external markets • The internet allows global branding and positioning and competitor analysis
Place	• Physical separation between buyers and sellers (Sheth et al., 1999) • Clearly defined markets and	• The internet has alleviated the physical separation between the company and its customer markets and its

4Ps	Old Theory	New Practice
	sales territories (Kotler, 1986) • Reliance on sales and distribution channels (Sheth and Gardener, 1988) • Use of intermediaries (Moller, 1992)	competition • Websites, email and new communication technologies allow customers to approach the company directly – anytime anywhere

Table 2-3: Re-interpreting the 4Ps of Marketing

The idea that marketing's 4Ps have been transformed and that the 'objects' that marketers are trying to understand are 'in a state of flux' is the central argument of Sheth and Sisodia (1999), who contend that "when a concept or framework has outlived its usefulness and serves more to impede and inhibit us than to illuminate reality in a meaningful and useful way, it becomes a set of binders that prevents scholars and practitioners from seeing the bigger picture" (p. 72).

Nevertheless, despite this apparent increase in the diversity and scope of what now constitutes marketing (Sheth and Sisodia, 1999), the quest for an empirical 'catch-all' description continues, driven largely by the premise that 'marketing is marketing' irrespective of the product or marketplace. While this notion was (and still is) common to many marketing texts and courses, two possible exceptions to this premise have emerged in the literature, namely 'the extended ingredients of the services marketing mix' and 'buying behavior models between consumers and business buyers', (Kotler, Armstrong, Saunders, Wong, 1998; Simkin, 2000).

2.9 Extending the Marketing Mix to Include Services

For Booms and Bitner (1981), these 'extended ingredients' prompted expansion of the marketing mix from the initial 4Ps to include 'people', 'physical evidence' (ambience) and 'process', arguing that 'services' required a different type of marketing. For Simkin (2000), service marketing is different owing to the basic characteristics of services, and cite the 'intangibility', 'direct organisation-client relationship' and 'consumer participation in the production process' as being key differences (p. 154). Simkin (2000) also argues that, compared with consumer goods, there is a 'much stronger customer service aspect' in the marketing of industrial products where the emphasis is on 'technical advice before the sale, ongoing customer support and aftermarket operations'. This focus on the service aspect of marketing is also reflected in practice, where initiation and development of the customer value proposition requires cross-functional engagement with key decision makers, purchase agents and influencers with the customer organisation (and customer network) in order to develop a unique understanding of *their* business 'issues and drivers'. In this way the customer is 'served', at cost to the firm, by collaborative assessment of the value benefits that, in theory, might accrue to the customer (and their customers). Again, practitioner experience suggests the importance of 'managing' a complex network of internal and external relationships, structures, and processes, placing emphasis on *marketing relationships* rather than *manipulating the market* through application of the 4Ps.

2.10 Consumer and Business-to-business Marketing

For industrial marketers, the consumer versus business dichotomy suggests that business-to-business (i.e. industrial) markets *are* different from consumer markets along a number of dimensions (Ames, 1970; Cook, 1986; Coviello and Brodie, 2001; Lilien, 1987). Lilien (1987) argues that business-to-business markets are unique due to their "derived demand, long purchasing cycles, and varying and fragmented market structure" (p. 3). Industrial buyers are further described by Lilien as heterogeneous in terms of their number and size, with "multiple individuals often involved in the purchase decision process" (p. 4).

Other differences between industrial and consumer marketing have been put forward. For example Chang and Simkin (1997) contrast the difference between consumer and industrial marketing from the perspective of 'competitive understanding'. Here, they argue, the tendency is for consumer marketing to focus on rival brands and marketing tactics, whereas in industrial marketing the focus is on the 'more difficult to attain' understanding of competitor strategic and tactical ‘intentions’. Further, branding for most industrial products is “less persuasive and emotive than the vast majority of consumer brands” (Simkin, 2000, p. 156), whereas industrial buyers are more inclined to remain loyal to their providers for as long as they are ‘satisfied’ with them. By contrast, consumers may exhibit ‘variety seeking behavior regardless of brand or product satisfaction’ (Hutt and Speh, 1995). Similarly von Hippel (1998) posits that industrial customers are more willing to communicate their needs than consumers are.

In contrast, other theorists and practitioners argue that the variations between consumer and industrial marketing lie only at the margins, and cite the lack of empirical studies that have examined whether the industry context (i.e. consumer vs. industrial) affects the degree of market orientation. Indeed studies of ‘market orientation’ and the ‘adoption of a market orientation’ by companies competing in different markets (i.e. consumer vs. industrial), show that the nature of industrial markets often calls for close co-operation between the producer of industrial goods and its customer for a ‘variety of issues pertaining to several aspects of the marketing mix’ (Gounaris and Avlonitis, 2001). The proposition here is that industrial marketing will also develop ‘market orientation both as a culture and as specific practices’ (p.357). Again, from the practitioner perspective, marketing management is about increasing profitable sales, irrespective of market context and it is therefore advisable to develop cooperative relationships with customers and suppliers. Indeed it may be that, in the changed business environment, normative and empirically tested industrial marketing practices associated with consumer or industrial marketing may now be in a state of transformation given that they may just reflect different tactical approaches from the same marketing tool kit. Thus where global branding of industrial technologies (as opposed to consumer products) have become increasingly common, so too, have 'relationship development practices' - normally associated with industrial marketing - become increasingly 'an alternative approach in consumer marketing' (Pels, 1999).

From a management perspective, Ames (1970) argues that industrial marketing is more of a 'general management responsibility' than in consumer firms, and even then noted that industrial markets are characterised by 'functional interdependence and buyer-seller interdependence.' This general management theme is also developed by Day (2004), who contends that marketing is the general management responsibility of the top team whose crucial tasks are "navigating through effective market sensing, articulating the new value proposition, and orchestrating by providing the essential glue that ensures a coherent whole" (p.19). From the customers point of view, Dhanani, O'Shaughnessy and Louw (1997), have also contended that this 'general' responsibility is particularly true for the transfer of technology where the 'dominant characteristic of marketing technology products is the high level of perceived risk associated with buying them' requiring a 'general responsibility' for marketing effort. Effective organisation wide marketing is therefore 'essential to allay adopter fears and risks' (Dhanani et al., 1997).

In view of the disparate and evolving perspectives on marketing, the American Marketing Association (1985), after much deliberation, suggested a particular view of marketing that sought to accommodate alternate perspectives. For the AMA, marketing could now be defined as:

> "…the process of planning and executing the conception, pricing, promotion, and distribution of ideas, goods, and services to create exchanges that satisfy individual and organisational goals" (p. 1).

But marketing's evolution did not stop. Other lines of enquiry began to emerge. For example Arias and Acebron (2001) argue that conventional research methodologies both in consumer and business-to-business marketing were modernist in nature, but their applicability in an increasingly postmodern business setting is 'decaying'. 'They are based on assumptions about the nature and behavior of markets and the access to knowledge about them' (i.e. that market phenomena result from the rational decisions of well-defined entities and can be observed as distinct measurable processes). These assumptions they argue, were developed in and for a world of mechanistic mass production and stable markets. However 'these conditions do not hold anymore' (p.7). The premise here is that marketing is in the middle of an 'epochal' transformation from the modern to the postmodern era, calling for 'major transformations in the way marketing is practiced, theorised, researched and evaluated' (Firat, Dholakia and Venkatesh, 1995; Rafiq and Ahmed, 1995; Sheth et al., 1999; Simakova and Neyland, 2008).

The theme of marketing transformation is also picked up by Forlani and Parthasarathy (2003) who argue that even if one accepts the premise that market definition is critical for developing entry strategies, current approaches are deficient because "the crux of their weakness is reliance on a static construct – time" (p.142). Many managers are thus experiencing a 'quickening of their decision making', with advances in communications technology and increasing demand for 'prompt data analysis and interpretation' all impacting on the time for decision making (Harvey and Novicevic, 2001). This theme is further developed by Lichtenthaler (2003), who argues that the complexity and dynamism of technology development makes it 'difficult to generate an information base of relevant technological trends' in order to support innovation and technology management decision making. Again, Matthyssens, Pauwels, and

Vandenbempt (2005) purport that the current dynamic business markets 'call for a new marketing approach and increasing strategic flexibility in business organisations'.

Concomitantly, there has been increasing agreement in the marketing literature that the marketing of technology based products differs significantly from the marketing of consumer-orientated products, with these differences attributed to the rapidly changing nature of 'high-tech' products and their markets, changing industry structures, and increased competitive pressure. Add to this internal market challenges as a consequence of changing organisational competency requirements, workforce transience, and the ongoing cycle of business re-engineering, and for marketing managers and theorists alike, it has become difficult to anticipate changes in the marketing situation. For many practitioners, it has thus become increasingly difficult to anticipate the firm's technological future, let alone analyze and predict the complex changes occurring in the marketing environment.

It is not surprising then that managers often wonder whether development of marketing plans and strategies are a worthwhile exercise (read: put in the bottom drawer). After all, companies hard pressed by competitive pressure find it difficult to keep up with changes in demand, competitors, and new technology developments in their 'market space', and at the same time accommodate possible future technology trends and resource requirements. Now, *more than ever*, the attention of marketing managers requires focus and competence across a wide range of diverse marketing activities. As was reported by Ashill and Jobber (2001) in 'Defining the Information Needs of Marketing Managers', …'the 20 senior marketing executives…identified themselves as being involved in a wide variety of tasks and processes that entail dealing with events which are complex and uncertain' (p. 57).

Thus for marketing scholarship the debate continues about what constitutes the domain of marketing, evidenced by the 'endless' debate and division between marketing theorists and practitioners (Levy, 2002). As a result, marketing has yet to embrace an all encompassing identity that reflects both the continuing theoretical debate as to what actually constitutes marketing, and recent developments in 'new' economy marketing practice (Burton, 2005; Gummesson, 2002a; Grönroos, 2002; Hunt, 2002b; Morgan, 1996; Sheth, 2002).

Indeed it can be said that, while theorists and practitioners generally agree that the nature and scope of marketing has expanded, the definitions and descriptions that prevail seem too narrow in their form or have so much latitude that they offer no practical foundation for conceptualising marketing. It is not therefore surprising that there is "little integrative marketing theory on a higher level of abstraction and generalisation, but there is no shortage of fragmented textbook theory that piles ideas, concepts, models, survey data, cases and hypothesis on top of one another" (Gummesson, 2004a, p. 20).

This conundrum for marketing theory and practice can be represented as:

Marketing theory → Gap ← Marketing Practice

Marketing Theory → Gap ← Unified Marketing Theory

Marketing Practice → Gap ← Changed Marketing Environment

Notwithstanding marketing's ongoing conundrum, yet another definition was put forward by the American Marketing Association in 2004, presumably as an attempt to accommodate the new business environment and the perceived transformation and evolution of marketing's conceptual 'mix':

> "Marketing is an organisational function and a set of processes for creating, communicating and delivering value to customers and for managing customer relationships in ways that benefit the organisation and its stakeholders" (American Marketing Association, 2004).

No doubt this definition found resonance with theorists and practitioners alike in that it contains themes common in most explanations of marketing – the ability to satisfy customers, the exchange of good or service 'value', the identification of favourable marketing opportunities, – but, arguably, it does not reflect the 'new' market environment either in practice or in theory. Certainly it offers no guidance or description as to the 'role' marketing plays in the delivery of 'value'.

Where, for example, are the more contemporary constructs of relationship management, knowledge management, and technology transfer – considered the ‘building blocks’ of new economy organisations (Walters, Halliday and Glaser, 2002) reflected in the ‘definition? Or for that matter, what of the ‘internal market’ or the ‘customer as co-producer’ (Prahalad, 2004)? Could it be that the business environment, the greatest of marketing’s levellers, had continued to change? Could it be that the AMA definition lags behind contemporary marketing practice? Certainly marketing scholarship and marketing practice have begun, albeit haphazardly, to question the notion of clearly defined markets and customers and challenge the ‘goods dominant logic that views units of output as *the* central components of exchange’ (Lusch, Vargo and O’Brien, 2007). Was it that the demise of conventional transaction based marketing that had long being forecast had finally come to pass (Brady and Davis, 1993)? Was marketing’s theoretical role now less to do with ‘operand’ resources (e.g. machinery, raw materials, and products – and the 4Ps), and more to do with the ‘operant’ skills and the knowledge of individual employees, organisations (i.e. firm technological knowledge and technical competency), information (i.e. knowledge about market sectors and competitors) and relationships (i.e. relationships with competitors, suppliers, and customers) (Hunt, 2004; Lusch et al., 2007)? Has the changed environment brought with it an apparent new era for marketing, in turn requiring marketing practitioners and theorists to continue redefining marketing's role and the competency requirements (activities and processes) of those who practice it? Certainly it seems that marketing scholars have so far 'failed to create dynamic theories, models, and conceptual frameworks that truly reflect a real world context' (Svensson, 2001, p.98).

2.11 New Ways to Create Value

Increasingly marketing theory is reporting that for companies of the twenty-first century the creation of value will increasingly depend on intangible assets such as knowledge, systems, data, intellectual property, brands, and market and network relationships. Of particular interest has been the significant amount of attention given to the study of networks and the interdependencies and collaborative activity of industrial firms (Hagel and Singer,1999; Quinn, 2000).

Importantly, these 'collaborations' are not taking place in isolation, and for theorists like Welch and Wilkinson (2004) they are occurring between firms who are interacting with and depending on other types of transactions and interactions taking place within the firms involved, including buying and selling groups, inter-functional interactions and relations (Wilkinson, 2001). Similarly, others like Hakansson and Snehota (1995) point out that much of the research in business marketing is now focusing on how firms do and should go about identifying potential customers and segments, and how to efficiently and effectively create and deliver value. Where in the past the focus was on what target markets to aim at and how to allocate resources to marketing, the focus has increasingly moved to relational transactions and the potential for value creation through relational exchanges.

In this context, the firm can experience direct and indirect outcomes from relational transactions, where direct outcomes relate to the benefits and costs associated with carrying out the transaction itself, and indirect outcomes result from the way the transaction is linked to other transactions with the same or different partners, creating opportunities for further business (Hakansson and Snehota, 1998). In this way value can be co-produced through the interactions taking place, and for firms focussed on R&D and technology transfer, these interactions create other indirect benefits as a consequence of their relations with customers and supply chain networks. For example, innovation and technology development can occur through 'co-integration' (Kleinaltenkamp and Jacob, 2002) and though 'innovation in relations and networks' which enable the easy transmission of ideas, technology, and service developments (von Hippel, 1998).

Much of this 'networked' and 'interaction' view of business marketing originates in research associated with the IMP group and the interaction approach which shifted attention away from assumptions that firms operate in market and network structures with the marketing 'problem' couched in terms of what target market segments to aim at and how to allocate resources – the marketing mix – so as to best achieve the firms goals (Wilkinson 2006). By contrast, theorists in the IMP group shifted their focus from this "essentially one-way stimulus response view of marketing to one in which the customer was viewed as active as well" (p.460). IMP group research thus focuses on the dynamic and interactive nature of the issues at hand, with each actor theorised to act in the context of the actions and reactions of others that it does not and cannot fully control. Interfirm relations and networks therefore involve co-created and co-produced behaviour.

However, this potential for collaborative effort is not just confined to external markets and networks. Internally, a firm's ability to create and deliver value to customers depends on the relations and interactions that exist among the people and units of the firm, such as relations between sales and marketing, marketing and R&D, and among divisions selling different products and services, or between purchasing and other functions. Research on product development, for example has shown how the pattern of relations and interactions among the departments and people involved affects the speed and effectiveness of the technology transfer process (Ulrich and Eppinger, 2000).

Arguably, value creation for the firm has become one of managing their actions and interactions with others so as to preserve and promote a productive and valuable role for their firm in the networks of which they are a part. In many ways, change in emphasis for firm marketing indicates, perceptibly, a change in the marketing environment.

Theme Two: The Changed Marketing Environment

Given the preponderance of management literature describing the 'new' environment and its impact on business practices, it seems reasonable to suggest that the way marketing is conceptualised and practiced will, as a consequence, be fundamentally altered. Indeed, for many scholars, this new 'age' has *radically* changed the way firms organise themselves (activities and processes) to profitably deliver value to their customers. The impact of the globalisation and the internet and the resultant boundaryless markets, sectors, industries and value chains has "created a new hypercompetitive landscape, one in which events, competitors, environments, and industries change constantly and unpredictably" (Harvey et al., 2001). As has been noted, few things impact a marketing manager quite like environmental change.

With this 'transition' in the business environment it is no wonder that 'fierce debate' among marketing scholars continues as to what actually constitutes marketing and how might it be practiced (Achrol and Kotler, 1999; Levy, 2002). Thus, while there may be ready acknowledgment of the 'new' business environment, theorists and practitioners have been slow to reflect marketing's role within it – serving perhaps as a warning to firms who ignore its impact on their markets, customers and competitors. In their book *Competing for the Future*, strategists Hamel and Prahalad (1994) point to new competitive realities that have 'ruptured' industry boundaries, 'overthrown much of standard management practice', and rendered conventional models of strategy and growth 'obsolete'. For these authors, any organisation that fails to engage with this new reality will watch as their 'structure, values, and skills become progressively less attuned to industry realities' (Hamel et al., 1994, p.9).

In this study, the literature that pertained to the purported 'epochal' change in the business environment reveals a number of increasingly pervasive themes, identified in Figure 2-4, each having a particular relevance to marketing practice and theory. These themes are now discussed.

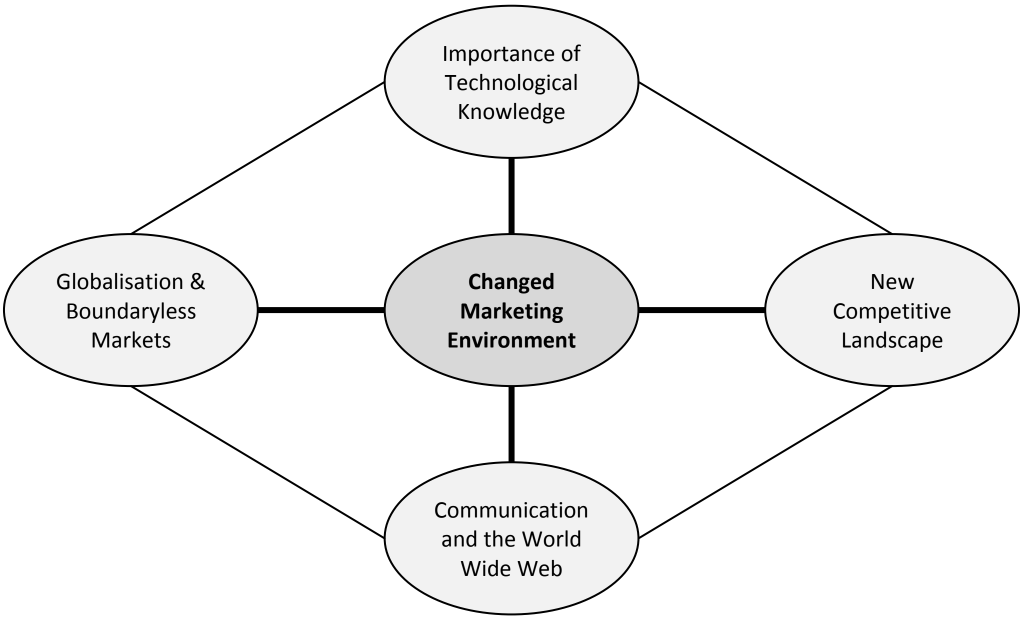


Figure 2-4: Literature Themes in the New Economy

2.11 Globalisation, Boundaryless Markets and the Knowledge Economy

Globalisation is shaping the economic environments of the world's economies, creating potential global market opportunities - but at the same time creating many challenges to the practice of marketing. This trend towards globalisation of markets was recognised by Levitt (1983) more three decades ago, although subsequently globalisation processes have intensified to the point where they are 'impacting every facet of business today' (Oumlil and Rao, 2005). In many respects the spread of new communication and information technologies and the internet have intensified the globalisation of market opportunities, requiring marketing infrastructures and management processes to become more sophisticated and technologically savvy. At the same time consumers all over the world are becoming more demanding and long established global brands are being challenged by new brands in both domestic and global markets. The net effect of all this globalisation is that markets are getting more intensely competitive (see for example Flint, 2004; Hofstede, Wedel, Steenkamp, 2002; Kitchen and Eagle, 2002; Nakata, 2002). Owing to globalisation, more firms than ever are attempting to bridge diverse cultures and traverse national boundaries, although as might be expected, the literature provides little guidance on operationalising the marketing concept in complex geographically distributed enterprises. While many studies have examined market 'orientation' from single and multi-country perspectives, and 'cultural' issues and challenges, 'none have focused on the process of implementing the marketing concept within the multinational environment' (Nakata, 2002, p.40).

For many contemporary scholars, the global business environment has begun to blur the lines across all markets (e.g. business and consumer) - making answering the proverbial question - 'what business are we in?' – an increasingly complex proposition (see for example Henneberg, Mouzas, and Naude, 2006; Ford and Hakansson, 2006; Hunt, Arnett and Madhavaram, 2006). These blurred lines are perhaps best encapsulated by Wind, (2006, p.475), who suggests five key themes:

1. A convergence of B2B and B2C markets, driven by the development of the internet and the rise of small businesses
2. A blurring of value chains through outsourcing and other relationships that allow networks of firms to do what was once done in the firm
3. A blurring of relationships with customers, as customers are invited to participate with companies in the design and delivery processes
4. A blurring of functions within the firm as marketing and other functions are more integrated through EDI and other systems
5. A blurring of products, services and customer experience, moving from an ‘industrial’ base to a knowledge-based society.

Given that this ‘boundaryless’ environment represents a series of most significant environmental challenges for marketers, it is no wonder that scholars like Walters et al. (2002) conclude that “old structures have been challenged, and concepts revisited and revised”, and suggest the need for new organisational structures “with which to take full advantage of the market place opportunities which should develop” (p.775). Quite simply, the idea of ‘markets’ within received economic and marketing theory does not seem to relate very closely to the contemporary business environment that concerns this study.

2.12 The Internet, Communications, and the Changed Competitive Landscape

It is said that the World Wide Web possesses unique characteristics which distinguish it in important ways from traditional commercial communications (Hoffman and Novak, 1997), presenting a fundamentally different environment for marketing activities as compared to the more traditional media activities of advertising and promotions. For many scholars, these changes in the 'market space' portend an evolution and transformation of the "marketing concept". It is asserted that in order for marketing efforts to be successful in this new medium, a new business paradigm is required "in which the marketing function is reconstructed to facilitate electronic commerce in the emerging electronic society underlying the Web" (Hoffman et al., p.1).

While there are wildly differing estimates for the growth rate of the Internet, the number of Internet users is variously given as increasing at 20 or 50 percent per year, and the traffic on the Internet is sometimes reported as doubling every three months (Hoffman et al., 1997; Stratton and Wong, 1997). This has had enormous ramifications for business. Today, any organisation can communicate with customers by establishing, at relatively low cost, a web site that enables almost instantaneous communication. Likewise the ability to obtain customer requirements, and preferences (market research) once the domain of multinationals, is 'now within the reach of even the smallest firm' (Lynn, Maltz, Jurkat and Hammer, 1999). As recently as the early 1990s, a firm looking to establish a large marketing database required a significant investment in mini-computer or mainframe technologies costing hundreds of thousands of dollars. Now, the internet enables small firms to level the playing field of their larger competitors by using the internet for global advertising, as low cost electronic communications with customers, and by using mobile technologies such as cellular telephones and laptop computers, for order-taking and field sales. In effect, the world wide web has become an efficient channel for advertising, marketing and distributing goods and services, and firms are now able to 'establish a local presence with a global reach on a shoestring budget' (Lynne et al., 1999, p.10). This sudden ability has also impacted internal market communications, with use of the intranet and email enabling easy, real time and cost effective communications throughout the organisation no matter how geographically spread it might be.

There can be no doubt that the internet is changing the emphasis of marketing. Now, internal and external markets and networks are inexorably linked, forcing marketing to undergo somewhat of a transformation. Use of information communication technologies have revolutionised business processes and practices and have reduced the time and place barriers of doing business. Traditional 'marketing theories' based on retailing, inventory management, logistics and physical distribution are having to be 'redefined' now that customers and suppliers connect on a real time basis anytime and anywhere (Sheth and Parvatiyar, 2001).

Clearly, the marketing environment has undergone what Halal and Taylor (2002) describe as "an avalanche of economic change" (p. 255). Events are accelerating to produce 'ever more complex technologies, intense competition, and turbulent constant change' (Halal, 1988). This is a problem for marketing theorists and practitioners because theory and practice now appear to lag behind the new business environment. Indeed, for Gummesson, "marketing as it is taught and researched today is a relic of the 1960's, patched up with decorations such as services, relationships and e-business" (2002b, p. 585). At the same time, marketing as it is practiced today still hangs on to old ways of thinking - the 4Ps - and struggles with the idea that competitive advantage is increasingly linked to innovation ability and the commercialisation of technology and technological knowledge. Consequently, the time may be right for marketing to re-examine its role in the organisation, and re-evaluate the activities and practices that promote technology transfer outcomes. In short, marketing may need to transform.

Theme Three: Technology Transfer and the Marketing of Technology Products

In practice, managing technology development and transfer is highly complex and process driven. It involves multiple functions, is often serendipitous and *always* takes more time and resource than at first thought.

In theory, technology innovation and transfer is also seen as problematic, and is well summed up by Christensen and Raynor (2003), who state:

> "Despite the best efforts of remarkably talented people, most attempts to create successful new products fail. Over 60 percent of all new-product development efforts are scuttled before they ever reach the market. Of the 40 percent that do see the light of day, 40 percent fail to become profitable and are withdrawn from the market. By the time you add it all up, three-quarters of the money spent in product development investments result in products that do not succeed commercially" (p. 73).

The high failure rates of new products alongside their 'indisputable importance for the well-being of contemporary organisations' has provided the impetus for much empirical work (Tzokas, Saren, and Brownlie, 1997, p.331), and underscores the intent of this thesis. Indeed it is this highly 'problematic' but critical process of organisational technology transfer occurring within the context of a highly competitive global business environment that provide the challenge for this thesis.

As was the case reviewing the marketing literature, a number of themes emerged during the initial review of the technology management literature. Essentially, these themes related to a view that saw technology transfer as a 'problem' to be solved either:

1. Through the organisation (internal market)
2. Between different organisations (external market)
3. Pertaining to the actual innovation process (creating and developing technology)
4. Pertaining to the commercialisation and diffusion process (managing technology adoption).

In each of these contexts, the notion of technology transfer is seen as problematic, with wide-ranging discussion on issues associated with functional integration of R&D, marketing and operational activities, and on issues relating to supplier and customer assimilation into the innovation process (Czuchry and Yasin, 1999; Littler, Leverick and Bruce, 1995; Rothwell and Zegveld, 1985; Souder, 1987; Tapp and Hughes, 2004). Many empirical studies have also suggested that important relationships exist between proficiently performed new product development (NPD) effort and the success of new industrial products, and between innovation success and the degree of integration among organisations that participate in NPD effort (Cooper and Kleinschmidt, 1987; Kotler, 1997; Lewis, 2001).

However, the literature pertaining to the role that marketing might play in the technology transfer process is less well developed, indicating a need for further theory development. A number of theoretical gaps have emerged, the most notable being the lack of an integrating theory for the role of marketing within the firm's external and internal technology transfer processes. This point is forcefully made by Svensson (2001), who argues that, while the marketing concept "has been of substantial importance"….."it is doubtful if this crucial knowledge…has been generally applied in the theory building, the modeling, or the development of conceptual frameworks in the academic fields of marketing during the twentieth century" (p.95). Others, like Tapp and Hughes (2004) argue that much of what has been written has 'focused on predictions of macro market changes, rather less has been written about how new technology has affected the internal workings of firms, in particular the marketing function', and that there 'remains a mismatch between marketing practice and marketing theory' (p. 284). Purportedly, the rules have changed – a new environment exists for the marketing manager who now practices in a dynamic technologically driven environment where 'evolution of internal and external market structures is rapid' (Shepherd and Pervaiz, 2000).

Indeed, it is further suggested that the traditional marketing paradigm, established over five decades ago, is out of step with the major changes occurring within both the marketing environment and business organisations. Markets are now more global and technologically sophisticated, competition more intense, and consumers more demanding. As such, information, communication and service issues are becoming increasingly important to business. Related to this, new types of business organisations are emerging based on relationships, alliances and networks. Now the requirement for the industrial marketing manager is, or should be, simultaneous marketing engagement *within* and *between* organisations, and marketing involvement in the organisations *innovation* and *technology transfer processes.*

This section of the review is structured as follows. The literature pertaining to firm technology transfer is discussed, together with its relationship to contemporary marketing theory and practice. The intent is to compare and contrast the themes identified in the marketing and technology literatures (informed by multiple lenses) to assist in identifying theoretical gaps pertinent to understanding marketing's conceptual role in processes associated with firm technology 'innovation', 'development' and 'commercialisation'. Again, the author's practitioner perspective serves to both arbiter the purported mismatch between marketing theory and practice, and illuminate the marketing themes that transcend firm technology transfer in the new environment.

2.13 Technology Innovation

The central role of innovation both at macroeconomic and microeconomic levels is now well established in the literature with new product development arguably the single most important issue facing managers today (Cravens, Piercy and Low, 2002; Hult, Hurley and Knight, 2003; Liyanage and Poon, 2003; Montoya-Weiss and Calantone, 1994). Consequently, the search for new methods and techniques to improve innovation processes has grown, both internally via the introduction of new product development activities and processes, and externally via the interface between firms, their customers, and their suppliers.
As a consequence, today's business environment is characterised by successive introduction of next generation products, and firms must now innovate and invest in new product development effort in an attempt to attain competitive advantage and induce higher profits.

Innovation is *always* described as a complex process, and one that is 'critically important for organisational success - yet not that easily managed' (Ahmed, 1988), and as international competition intensifies and life cycles shorten, the 'pressure to innovate heightens'. For Ahmed, (1998) successful innovation has become "critical to adjusting and adapting to changes in technology, markets and competition" (p.45).

The actual practice of innovation has variously been defined as 'an idea, practice or object perceived as new by an individual' (Rogers, 1983) or as 'new production inputs, machines, processes, and techniques adopted by firms or entrepreneurs for their own use' (Brown, 1981). Others like Behrman and Wallander, (1976) characterise the innovation process as being 'lengthy and people intensive' with firms moving technology and technological knowledge between functional areas and through documentation, equipment, training, people, and management systems.

Despite the growing base of literature on product innovation (Cooper,1983; Zirger and Madique, 1990), and on organisational innovation (Nevens, Summe, and Uttal, 1990; Wheelright and Clark, 1992) and on the determinants of innovation, 'understanding of ideal practices for innovation remains patchy' (Ahmed. 1998). Nevertheless, there is general agreement that actual innovation processes vary between organisations, and that 'technological innovation fundamentally takes place within a competitive and conflicting atmosphere' (Allen, 2000). In parallel, others like Hattori and Wycoff (2002) suggest that there is still much to learn about innovation and purvey a new approach to creativity which places innovation resources in 'business units' and emphasises 'teamwork'.

This theme of 'teamwork' is also reported by Tzokas et al., (1997), who argue that the R&D process should be approached not only as a technical exercise, but as a "social interaction that embraces both technical and marketing activities" (p. 332). The notion of internal market collaboration (teamwork and cooperation) has also been highlighted in studies seeking to 'benchmark' the factors that promote organisational innovation activity. For example, organisation-wide involvement in the innovation process has also been researched by Maidique and Zirger (1984), who identified aspects of marketing as being critical to innovation. An extensive literature review by Zairi (1995) produced a list of factors 'that are thought to impinge greatly on the degree of success in innovation management' (p. 39). These innovation 'factors' and the activities associated with them are represented in Table 2-4:

Innovation Factors	Description	
Discovery and Idea Creation	Integral part of strategic market planning; innovation promotes competitiveness; use of all organisational skills as and when required; use of tools and techniques	**What is marketing's role in firm innovation activity?**
Top Management Commitment	Create a climate for innovation; actively support all innovation processes	
Effective Communication Processes	From the corporate level downwards; clear objectives and understanding of what the goal is; sharing of information on results and action plans	
Participative Style of Management	Distributed approach to decision-making and full support from top management,	
Managing Innovation is Project Based	Use of multi-disciplinary teams; formal and informal reporting mechanisms and measurement; driven by a thorough understanding of customer requirements, process capability and ultimate organisational goals; reliance on the creative contributions of all functions; systems are in place to track down killer variables; ability of project leaders, teams and managers to decide on project termination or advancement	

Table 2-4: Factors Influencing Innovation Activity
(Source: Zairi, 1995)

While Maidique and Zirger's (1984) and Zairi's (1995) lists may not be exhaustive, one thing that is clear is the theme of organisation-wide (internal market) involvement. Indeed their lists both suggest that everybody in the organisation is in some way involved in the innovation process, and that relationships', communication, and technical and market knowledge play important roles. The overriding question for the marketing manager thus becomes: *what is marketing's role in firm innovation activity?*

The theme of innovation crossing both functional and disciplinary boundaries is repeated in many reviews of process-based approaches to technology management (e.g. Clark and Fujimoto, 1991; and Zairi, 1995). Taking another perspective on innovation, Voss, Chiesa, and Coughlan (1994) sought to identify core 'business processes, the enabling factors, and the outcomes of the business processes'. Taking a top down approach, they concluded that product innovation can be viewed as a set of four main business processes (p.86):

1. Product innovation the process of bringing together technology and market needs to develop new product concepts
2. Production development: the process of bringing a new product concept through development and manufacturing to the market
3. Production process innovation: the process of innovating and developing new production processes
4. Technology acquisition: the process of acquiring the technology necessary for product and process innovation through internal R&D and/or other means.

However, the difficulty with these so called 'best practice' lists is that they infer that product innovation and development processes are controllable, rational and linear. In practice, this ignores the very many setbacks, detours and roadblocks that are part of the complexity of the innovation process. Add to this the uncertainty of dynamic customer markets, and these promulgated innovation practices seem increasingly at odds with the business environment. For example, there is no reference to customer or network cooperation in the innovation process, much less to the concept of 'relationship' - yet in an era of mass customisation (Czuchry et al., 1999; Poolton and Ismail, 2000), listening to the voice of the customer should be a prime driver for innovation and new product development. Indeed it is suggested that any 'best practice' list is likely to become quickly outmoded given high levels of turbulence in a changing business environment.

In the main, the literature argues that innovation and the conditions that help it flourish are influenced at individual, team or group, and organisational levels (Cooper and Kleinschmidt, 1987; Cooper, 2005) and that the structures, processes and activities outlined above can enhance innovation performance. What the literature does not so readily reveal however, is *how* these activities and processes are promoted, operationalised and managed within the organisation. If it can be said that the very nature of innovation necessitates teamwork and collaboration, then the question might very well be asked *whose 'role' is it to promote innovation activities and processes anyway?*

Further, other than the obvious 'alignment with customer and market needs' there seems to be little guidance in the literature as to marketing's role in developing and promoting innovation activities. More specifically, perhaps now the question should be *what is marketing's role in the discovery and promotion of firm technological knowledge and technical capability?*

Indeed, it is suggested that promoting organisational innovation in the contemporary environment now requires (new) innovative marketing approaches that, for example, see marketing as the conduit for identifying, developing, packaging and promoting the firms innovative abilities, technical competencies and technological knowledge as a way to gain competitive advantage. In essence, should marketing's involvement in innovation now be a critical part of marketing's 'mix' of activities?

2.14 Marketing and Innovation

It is by now also widely acknowledged that the marketing function should enter the innovation process at its earliest stages, maintain effective co-operation with R&D and other functional units of the firm throughout the technology development process and assume primary responsibility for market launch (Cooper, 2005; Cooper and Kleinschmidt, 1987; Huang, Soutar, and Brown, 2001; Maidique et al., 1984; Poolton and Ismail, 2000). Theoretically, marketing involvement at the 'discovery' phase enables the innovation to be reflected against likely industry, sector, and customers targets. This early market connectivity thus generates competitive intelligence, ultimately leading to decisions about market value, competitive position, and marketing strategies and tactics. Indeed the literature provides extensive support for the basic proposition that marketing involvement in the planning and executing of new product development strategies is crucial (Butler, Coates, Pike, Price and Turner, 1996; Song and Parry, 1997; Zinkham and Pereira, 1994).

For the practitioner, the reality is somewhat different. In the first instance, marketing involvement in 'innovation' wrestles with the same problem that, arguably, besets marketing in general. That is, while theory may support marketing involvement in innovation activities (i.e. early market connectivity), invariably this 'conceptual knowledge' – even if it exists in the minds of 'innovators' – is seldom activated. A distinction is made here between 'conceptual' and 'instrumental' knowledge. Conceptual use is what Deshpande (1982) describes as "knowledge for understanding", as opposed to instrumental use, which is described as "knowledge for action". Put another way, while the firm may have the competence to generate technical innovations *and* conceptual knowledge of market 'needs', experience suggests that in most cases the marketing activities and processes associated with promoting and commercialising firm innovations and firm innovative ability are lacking *or do not exist at all*. Thus, it is suggested that failure to evaluate and apply marketing 'resources' (read: activities and practices) will likely see a continuation of the failure rates in technology transfer that Hart, Tzokas, Saren (1999) describe as 'marginal improvements on previous decades'

Secondly, and perhaps more significantly, the innovation literature reveals a surprising gap with respect to marketing's theoretical involvement in identifying and developing innovative technological abilities within the firm's internal market - and then promoting these abilities to external markets. If it is accepted that a key characteristic of the 'new' economy is its knowledge based nature (Floricel and Miller, 2003), and that new knowledge is primarily 'scientific and technological' and about 'user needs, market dynamics and organisational processes' (p. 502), then a new and critical role for marketing thus emerges within the context of developing firm innovation ability and technology transfer.

The proposition here relates to a perceived need for marketing to institute activities and practices that serve to encourage and develop firm innovation potential. In this context, marketing's role becomes one of identifying and promoting activities and processes within the firm's internal market that build innovative capacity and then 'linking' this ability to external markets' and networks in order to generate and transfer innovative technologies and technological knowledge. The question: *what is marketing's role in firm innovation* is represented in Figure 2-5.

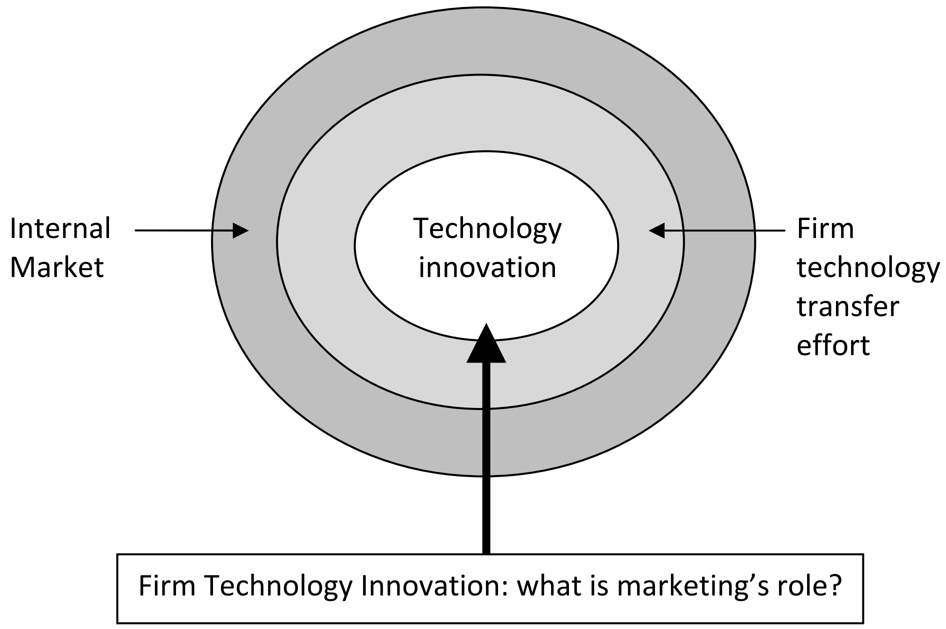


Figure 2-5: Conceptualising Marketing's Role in Technology Innovation

2.15 Technology Development

For the author, two themes have particular resonance after twenty years as a practitioner. If the first is realisation that the business environment has gone global and that everybody can be in everybody else's market, the second is surely the impact of technology and technology products. Apart from the internet, every facet of product and process development has been subject to massive technological change, with technology development at its very core. It seemed as if *every industry* was impacted by, and reacting to, new product and process technologies. But these changes went beyond merely 'bigger, faster, stronger'. A paradigm shift in business was taking place, because technology now enabled applications that had hitherto been construed as pertinent to one industry (or indeed one process) now had multiple applications in other industries – suddenly increasing the firms product and service potentials. Algorithms for calculating dwell times for timber drying now had application drying dairy products. Knowledge of tree chemical composition gave rise to energy repatriation in the pulp and paper industry. Advances in computer modeling now allowed weather events and their physical impact to be accurately forecast and electronically dispensed to multiple industries in multiple electronic forms days ahead of time; and mobile robots were now a significant part of steel manufacture, warehousing and distribution.

Not surprisingly, the importance placed on technology development is reflected in the number of studies undertaken over the last three decades, with the majority having a theme of identifying the factors associated with successful new product performance. Such studies have examined new product success (Cooper et al.,, 1987; Globe, Levy and Schwartz, 1973), new product failure (Cooper, 1975), comparison between success and failure (Maidique et al., 1983), and the R&D-marketing interface (Gupta, Raj, and Wilemon, 1986).

Generally the literature distinguishes three 'types' of technology: 'product' technology or the set of ideas embodied in the product; 'process' technology or the set of ideas involved in the manufacture of the product or service; and 'management' technology which relates to the set of management procedures associated with selling the product or service. The literature also distinguishes 'technology' from the more general notion of 'knowledge' itself, through the boundary between the two is often called 'fuzzy'. 'Technology' can be said to be 'intended for use' (Bell, 1973), and as such can be seen as a 'subset of knowledge' (Capon and Glazer, 1987).

In practice, the cumulative effects of these conceptualisations represent a change in the business environment. Increasingly, new product and process technologies have become important either as networked opportunities for the firm or as competing products aimed at the firm's customers. Indeed, new technologies and technological knowledge have the potential to threaten (established) buying behavior. In this sense, 'technology' and technological knowledge are at once an opportunity and a threat, and maximizing the 'opportunities' and mitigating the 'threats' has become an exercise in understanding the technological position of the firm's customer and supplier networks. Indeed, it is difficult to construct a meaningful customer value proposition without intimate knowledge of the customer and their 'technological position'.

Nevertheless, the idea that technology innovation and development represents an easy path toward firm competitive advantage is far from the truth. Thirty years of research has shown that the new product development process is based on a series of development stages that are interpolated by a series of evaluative stages or ‘gates’ (Cooper, 1990). Within each evaluation ‘gate’, management uses pre-specified criteria to assess whether different tasks have been performed efficiently and effectively, thereby assisting managers avoid ‘go’ and ‘no go’ errors during the development process as well as assisting in the planning of resource requirements (Tzokas, Hultink and Hart, 2004). However, while these criteria provide normative guidelines for new product development, the reality is that very few new products actually succeed in being commercialised (Cooper, 1987; Tzokas et al., 2004). High failure rates are thus a reoccurring theme in new product development.

Research has also shown that new product development (NPD) is critical to the growth and survival of modern businesses, and as a result, the quest for factors that underlie success has become a popular research direction in recent decades (Kotler, 1997; Rothwell, 1972; Schon, 1963). During this time, a number of reviews have summarised the key success factors highlighted in earlier studies, including Griffin and Page (1993), Hart (1996) and Karakaya and Kobu (1994).

Balachandra and Friar (1997) went as far as identifying 72 success factors from a total of 19 studies!

The overall significance of the NPD process is also well documented. The strategy, marketing, operations and technology literatures all contain 'studies conducted at different times, in different industries and using different methodologies' (Lewis, 2001). For Lewis (2001), two core assertions underpin interest in new product development. "It must firstly be difficult to develop successful new products because most NPD projects fail (Wall Street Journal, 13 January, 1992). Secondly, successful new products are the outcome of effective NPD processes" (p.185).

Lewis (2001) also contends that there often appears to be dislocation between input, process, outcome and context factors, arguing that effective cross-functionality is 'not a given' in many organisations. This of course is of particular interest to this study because the failure rate during new technology product development continues to remain *very* high despite well-documented success and failure criteria. Given the increasing importance of innovation and technology to provide firms the means by which to compete, it is thus not surprising that theorists and practitioners continue to place great importance on new product (and process) development, and again reinforce the intent of this study.

The review identified a series of marketing themes that pertained to new technology product success and failure, which are presented in Table 2-5:

Source	Success Criteria
Globe, Levy and Schwartz, 1973	• **Recognition of technical opportunity** • **Market need recognition** • **Proficient R&D management** • **Well executed venture decisions** • **Ample development resources**
Roberts and Burke, 1974	• **Close link to market needs**
Cooper, 1975; 1976; 1980	• **Marketing research especially near the beginning of the project** • **Having a unique superior product in the eyes of the customer** • **Having strong market knowledge and market inputs, and undertaking the market research and marketing tasks well** • **Having technological and production synergy**
Townsend, 1976	• **Close collaboration between user and innovator** • **Well defined market need** • **Technical champion** • **Strong internal communication** • **Highly developed screening and testing procedures**
Rothwell, 1972	• **Understanding users needs** • **Attention to marketing and publicity** • **Efficiency of development** • **Effective use of outside technology and external scientific communication** • **Seniority and authority of responsible managers**

Source	Success Criteria
Maidique and Zirger, 1984	• Proficiency in marketing and commits a significant amount of resources to selling and promoting the product • The create, make, and market functions are well coordinated • The markets and technologies of the new product benefit from the strengths of the firm • There is a high level of management support from the development stage through to launch
Winterscheid and McNabb, 1994	• 'Perceptual ability' as a way to recognise and match the firms technological knowledge stocks with an unfulfilled market niche • 'Capability to design and deliver' the new product once the match between technology and the market has been recognised
	Failure Criteria
Hopkins and Bailey, 1971	• Inadequate market analysis • Product defects • Lack of effective marketing effort • High costs • Bad timing • Competitive strength
Cooper, 1979	• Weak new product process • Lack of market research • Lack of test marketing • Limited financial evaluation

Table 2-5: Factors Influencing New Technology Product Success and Failure

The question posed here is *how much is technology transfer success (or lack of) related to marketing activities* rather than to the, by now, normative technical development 'processes' associated with new technology products? Where the literature reports the conditions for NPD success, the role of marketing in this process is less well explored. This is surprising, since in practice the very nature of new product and technology development necessitates co-ordination of external and internal marketing effort (i.e. linking market information and customer needs to technical development).

Table 2-5 contains a number of elements that are important to this study. Apart from reflecting themes of ‘technical competence’, ‘proficiency in marketing’, and ‘links to the customer’, it also suggests themes of internal and external market ‘service provision’, the importance of ‘knowledge’ in technology development and transfer, the requirement for internal and external market ‘relationships’ in the transfer process, and the need for adequate (marketing) ‘resources’ to effect internal and external market connectivity. Critically though, the table provides no real guidelines for marketers as to which activities and practices might be required to effect marketing engagement with firm technology development and transfer effort. How, for example, does the firm generate ‘innovation potential’ and how can firm ‘technological knowledge’ be identified and developed into technology products and then ‘transferred’ to customers? What is the customer’s role in firm technology development, and what marketing resources will be required for inter and intra-firm service provision and relationship development? These are key questions for today’s marketers, and go to the heart of the research question.

Of course the difficulty for both marketing theory development and for practitioners is that technology development occurs in an environment characterised as turbulent (Drucker, 1980; Walters et al., 2002), resulting in ‘sudden reassessments of the growth prospects of entire industries’ as well as 'dramatic upheavals in the relative position of firms within an industry' (Harris, Shaw and Sommers, 1981). The causes of such turbulence are both numerous and interdependent, but for Capon and Glazer, it is 'now apparent that a major engine of the unprecedented instability is technology, or more precisely, the emergence of rapidly changing technologies into the environment' (1987, p.1). These authors argue that in the long run, the economic performance of individual firms 'depends on how well they learn to manage and increase their technological asset bases' and further that 'technology strategy and its relationship to marketing strategy have not been given explicit formal consideration' (p.1). Perhaps more significantly for this study, these authors also contend that as fixed technologies and stable product markets give way to rapidly changing ones, 'technology itself becomes less proprietary, and the firms know-how quickly becomes everyone's, and possession is less important than access and use' (p.3).

Importantly, it would seem that the aforementioned gap between 'traditional marketing practice' and the perceived need to identify and grow the firm's innovation and technology development potential is becoming *the* nexus for engaging with external markets and networks. Filling this 'gap' thus requires marketers to identify specific areas of technological knowledge and know-how in order to find those having marketable 'value'. It is further suggested that these ‘value potentials’ are fast becoming central to firms product or service ‘offer’ and the means to compete, and as such are in the domain of marketing. Moreover, these ‘product and service potentials’ are - by extension – contained within the firm, requiring marketer’s to bring *innovative* solutions to the task of identifying and ‘assembling’ the firm’s technological competencies and capabilities in order to more effectively compete in external markets – an *organisational value proposition* if you will. Thus the internal market, its (realised) innovation potential, and network application of technology and technological knowledge has become, in itself, the new marketing mix.

2.16 Marketing and Technology Development

As previously noted, a central theme in the product development literature concerns the need for the marketing function to enter the technology development process at its early stages and maintain effective cooperation with R&D. However, examination of the extant literature revealed that marketing’s role in the actual technology *development* phase is not so widely studied. Beyond acceptance of the need for effective cooperation between marketing and R&D, and product-market connectivity, the marketing literature seems devoid of theory development in this area, again underscoring the intent of the thesis. This point is reinforced Czuchry et al., (1999) who contend that ‘systematic practical approaches to the marketing of technical innovations have been lacking’.

The successful marketing manager is, in many ways, an agent of change. Marketing managers must respond effectively to changes in domestic and global competition, product and process technologies, customer and supplier requirements, and regulatory matters. The marketing manager must also contend with the firm's perception of marketing and the role that marketing could or should play. Indeed, even if the firm realises the importance of the marketing function to support technology development, the collaborative skills required for the marketing and technical departments to function effectively as a team seem to be still the exception rather than the rule.

It is therefore not surprising that many authors argue that the technology development process should be approached not only as a technical exercise conducted by technical specialists but as a 'social interaction embracing both technical and marketing activities' (Tzokas et al., 1997). Behrman et al. (1976) characterise this interaction as being 'lengthy and people intensive' with firms moving technology between functional areas and through documentation, equipment, training, people, and management systems.

Supporting the notion of wider involvement of marketing in technology development, other scholars have adopted a process-based approach to assess policies and management practices in manufacturing and innovation management. Pavitt (1990) states that “a major criticism of the content view of technology strategy is that it neglects the context within which – and the process whereby – technological strategies are generated, then chosen and implemented”…and “these processes are bound to involve more than the technical function” (p.3). Others like Calantone, di Benedetto, and Divine (1993) maintain that successful integration of marketing and technology functions ‘requires a flexibility not found in traditional rigid organisational structures’.

In a normative sense, the *starting* requirement for industrial marketing managers is an ability to analyse markets and customers, develop product and service offers that match customer requirements, institute marketing plans, create value propositions defining customer *and* firm value potential, and facilitate and develop marketing services and relationships throughout customer and supplier networks. Experience shows that these even these tasks are not able to be achieved without the involvement of other functional members, necessitating what Czuchry et al., (1999) describe as ‘dynamic and systematic interaction’ with the wider organisation. And, as was stated at the onset, these tasks cannot easily be performed if individuals and groups, for whatever reason, do not engage with the ‘marketing concept’ and the need for meeting customer needs to enhance sales potential. With technology development now seen as a critical requirement for gaining and maintaining competitive advantage, it is suggested that a gap exists between the function of marketing and firm technology development.

The question: *what is marketing's role in technology development* is represented as Figure 2-6.

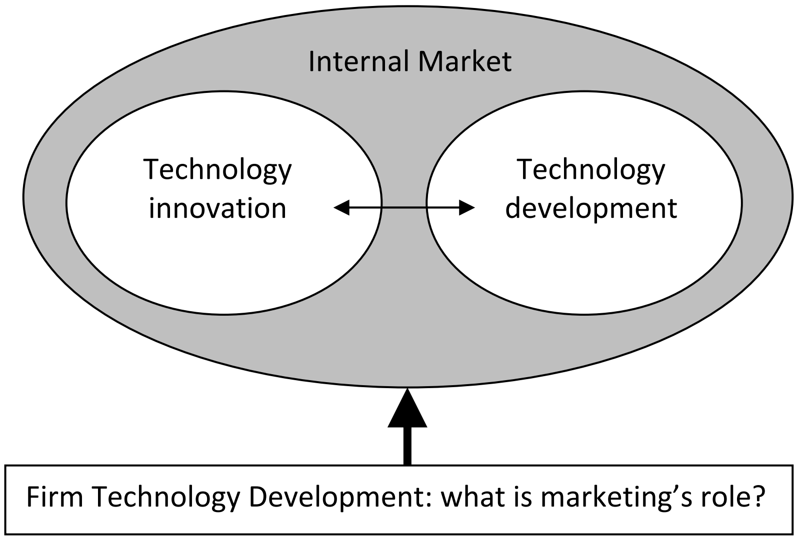


Figure 2-6: Conceptualising Marketing's Role in Technology Development

2.17 Technology Transfer

In practice, marketing involvement in technology transfer concerns the need for technology products and services that are developed (or acquired) by the firm, to be promoted and sold to targeted customers. For the marketing manager, the 'commercialising' of technology products and/or services in order to derive revenue streams is of paramount importance to the economic viability of the firm because, at the *transfer* stage, the firm has already invested significant technical, marketing and administrative resources during the technology *development* process. Indeed, technology product development from ‘idea to inception’ is often measured in years and in millions of dollars.

However, despite firm commitment to ‘technology development’, in practice securing firm commitment to allocating resources for ‘marketing’ (and thence transferring) technology developments is invariably a difficult proposition – despite general acknowledgment that ‘transfer’ of technology products is vital for firm economic health. The theme that resources are a central concern for firm technology transfer is persistent in the technology management literature and is mirrored in practice – being often referred to as ‘the valley of death’ or the ‘funding gap’ in describing the difficulty in securing firm resource to complete e.g. technical and commercial viability and proof-of-concept work. This theme is illustrated in Figure 2-7:

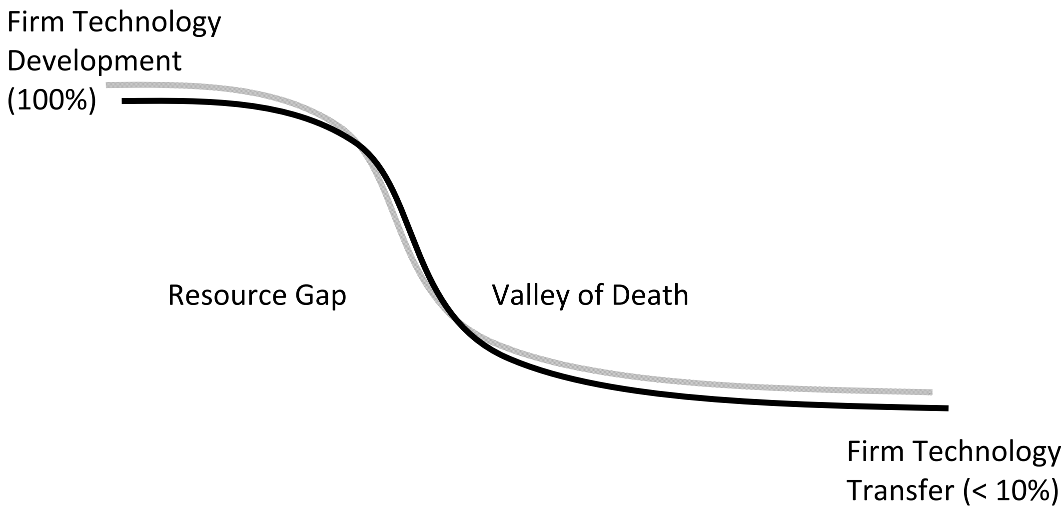


Figure 2-7: Resource Gaps in Firm Technology Transfer

This theme of lack of resources is significant for marketers because successful transfer of technology products always involves significant market research and extensive engagement with internal and external customer and supplier networks. Ultimately, it is this 'intangible' market knowledge that allows for the development of business relationships and the 'tailoring' of customer value propositions. Indeed, difficulty in securing adequate resources to effectively engage with customer networks is a common theme for practitioners, and perhaps goes some way to explaining the high failure rates in firm technology commercialisation. It also suggests that if the role (activities and processes) of marketing in the technology transfer process is not clear, then the provision of resources for technology marketing effort will likely be curtailed. In this context Pike, Roos and Marr (2005) contend that little research has concentrated on how best to deploy and utilise intangible resources within R&D organisations, with much of the work on resource allocation in R&D organisations focusing on financial resources and staffing (Scholefield, 1994).

In practice it seems as if firms involved in research and technology development do not understand how marketing resources and technological knowledge rely on each other to create value, leading to an R&D process that Dierickx and Cool (1989) describe as ‘stochastic and discontinuous’. It is suggested that, for technology transfer to be effective, the firm must first understand that marketing knowledge is a vital precursor to targeting and engaging potential customers, and while the nature of this knowledge is somewhat intangible, it nevertheless requires firm commitment to resourcing if market knowledge is to be collected. Effectively, a technical team cut off from the ‘market’ becomes impotent because it cannot hope to interpret accurately the needs of the customer without first gaining the perspective of the customer and the customer’s business environment. In practice, a theme for industrial marketers is the provision of marketing ‘services’ and the facilitation of internal and external ‘relationships’ so that that knowledge and technological capabilities can be developed and transferred for profit - firm ‘marketing resources’ so to speak.

2.18 Technology Marketing

Application of the basic principles (4Ps) of marketing to technologically fast changing markets is not straightforward, and can be attributed to very 'high levels of uncertainty' for the firm and its customers (Beard and Easingwood, 1992). This technological uncertainty creates unpredictable demand patterns with customers, who may be unsure of the real benefits they will derive from technology purchases. This uncertainty is further compounded by short product lifecycles and rapid obsolescence (Karakaya et al., 1994). In theory and practice, purchasing resistance by customers is thus extremely problematic for marketing managers.

Normative marketing principles are further challenged when considering that marketing technology products also requires a need to work co-operatively, to some degree, with the firm's research and development function (Bender, 1986). A common problem is a 'dominance' of 'things technical' in the innovation process, so that the translation of technical knowledge into marketable products tends to succeed only partly. Consequently, the literature reveals more theory development concerning NPD and technology transfer processes (i.e. studies concerned with innovation practices, technology product management and product-market connectivity) and rather less theory development concerning marketing's *actual* role within these processes - again highlighting the need for further theory development.

Bringing a superior technical innovation to market is also no guarantee of customer acceptance of the innovation (Gatignon and Robertson, 1989; Woodside, 1996). For Woodside (1996), this proposition holds even when the evidence is overwhelming that the 'adoption of the innovation will enable the customer to both dramatically decrease the customers product-service manufacturing costs and improve both performance and conformance quality of the customers delivered product-service to downstream customers (p. 25). For the industrial marketer, introducing superior technologies (compared to inferior performing, currently installed technologies) to the market often does not automatically translate into commercial success.

Within the technology management literature, the review highlighted a number of themes for supposed 'best practice' technology management. Three resounding themes emerged:

1. Early project kill decisions conserve resources
2. Strong links to the market improve technology transfer success
3. Knowledge and technological capability is increasingly becoming part of the technology development and transfer process.

Despite the term ‘technology’ developing as somewhat of a vogue description for products from a number of industries, there is general acknowledgement that it is indeed an area for which a particular approach to marketing is required (Gardner, Johnson, Lee, and Wilkinson, 2000; Meldrum, 1996; Moncrief and Cravens, 1999). It has also been observed that advanced technology and the technological aspects embedded within a product are an increasingly significant feature of products as they are presented to markets (Dutta, Narasimhan, and Rajiv, 1999) where traditionally it was the ‘product’ that assumed a higher profile (Popper and Buskirk, 1992). For Davidow (1986) this translates to a need to apply marketing principles to the management of technology products ‘from conception onward’, whereas for McKenna (1985) the marketing of technology products requires ‘concentration on communications strategies and tactics’.

However, while these scholars provide some insight into the issues industrial organisations face in relation to their markets, they do not adequately take account of the increasingly knowledge based and technology driven business-to-business environment, where business planning, for example, may be difficult due to changing industry boundaries or market entry of new technologies (Bean et al., 2002; Beard et al., 1992; Day et al., 1999; Hamel et al., 1991; Rich, 2002; Schlegelmilch and Sinkovics, 1998). Neither do they accommodate the critical dimension as to whether the technology generates unique marketing demands or whether the nature of the technology will have an impact on the way in which marketing is managed. These dimensions are critical to the industrial marketing manager, because in this context, industrial marketing is characterised by much smaller numbers of buyers or sellers than in consumer markets (Herbig et al., 1994), with long purchase cycles and product complexity that requires multiple individuals in the purchase decision process (Lilien, 1987; Webster, 1978).

Further, these observations as to what constitutes ‘marketing’ do not take account of what the *customer* would want marketing to be (Gronroos, 1989), or indeed suitably accommodate the more recent conceptual dimensions of knowledge management (Borg, 2001; Civi, 2000), relationship marketing (Aijo, 1996; Gummesson, 2002a) and technology transfer (Amesse and Cohendet, 2001; Douthwaite, Keatinge, and Park, 2001; Rogers, Takegami, and Yin, 2001).

For this study then, the question: *what is marketing’s role in technology transfer* is represented as Figure 2-8:

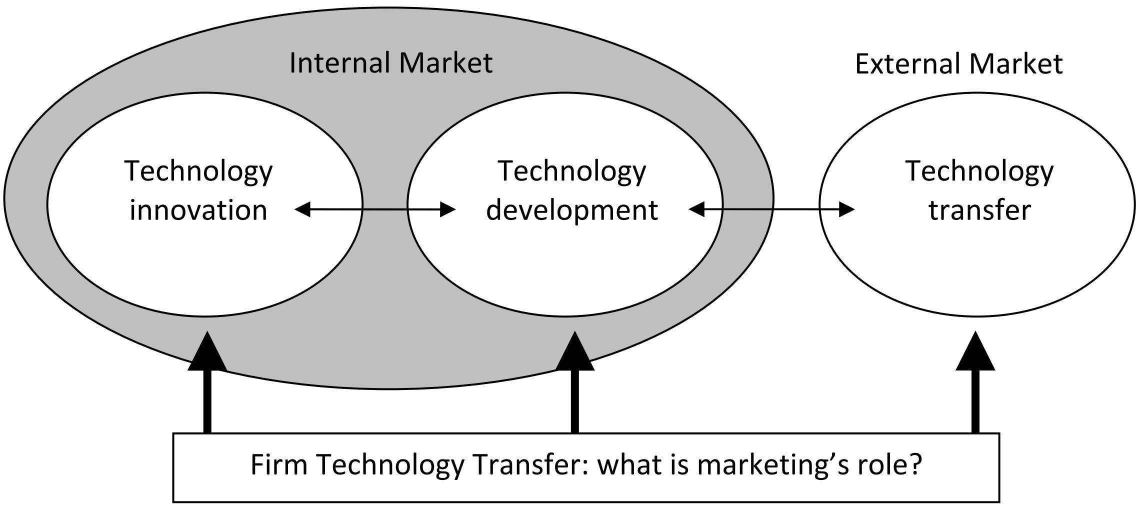


Figure 2-8: Conceptualising Marketing's Role in Technology Transfer

2.19 Technology Diffusion

The adoption (purchase) and diffusion (after-sale activities) of innovations is a subject that has been widely studied for three decades across a broad spectrum of disciplines, including social science, marketing, engineering and management. As Rogers (1986) points out, technology diffusion has emerged as 'one of the most multidisciplinary research topics in social science today'. This has led to a common diffusion paradigm.

Within this paradigm, several models exist to interpret and explain the diffusion of innovations (Van de Ven, Angle, and Poole, 1989), although the first well-known and widespread framework was Rogers (1983) model of diffusion.

According to Rogers,

> "…diffusion is the process by which an innovation is communicated through certain communication channels over time among members of a social system and an innovation is an idea, object or practice which is perceived as new by an individual or another unit of adoption" (p.19).

In other words the diffusion process is an information seeking and processing activity, or as Kautz (2000) put it, 'largely a communication process' (p.12). Studies have also addressed the technology adoption life cycle, which suggests that a different approach is necessary when marketing innovations to potential adopters (Foster, 1982). In this process, five generic stages are distinguished (Rogers, 1983):

1. <u>Knowledge</u> is the stage where a potential adopter learns about the existence of an innovation and gains some understanding of its way of functioning
2. <u>Persuasion</u> is the stage where a favourable or unfavourable attitude towards an innovation is formed
3. <u>Decision</u> is the stage where activities are undertaken which lead to the adoption or rejection of an innovation
4. <u>Implementation</u> is the stage where an innovation is actually put to use
5. <u>Confirmation</u> is the stage of reinforcement for an adoption decision that has already been made.

In contrast, other scholars have argued that it is not enough to consider traditional diffusion theory, even combined with a market orientated integration of R&D and marketing in the product development phase:

> "Once the decision to buy the system is made, it is the internal diffusion system in the buyer organisation…which may be pivotal…marketers of high-technology innovations cannot stop their efforts at the decision to buy. Instead, marketers must continue to participate by encouraging the internal diffusion of the innovation among the adopting organisation. This continuation of marketing effort past the initial sale is critical to the ultimate success of the innovation and, indeed, to the viability of the selling companies itself" (Higgins *et al*., 1999, p.62).

Moore (1995) in Higgins and Hogan, (1999) examines the difficult process of successfully marketing innovations to segments beyond the early adopters. Moore contends that the appropriate approach in high-tech marketing must be on the 'whole product solution', and that the product offering must provide applications with exemplary added value if the high-tech product is ever going to gain acceptance in the mainstream market. "Since virtually all the wealth-building sales come from this mainstream market, achieving this sales level is of 'paramount importance to marketers" (Higgins et al., 1999, p. 62).

For the marketing manager it may be more important to know what an organisation does (implementation) than what it has decided to do (adoption).

“The technology has to be implemented, or all the effort is wasted” (Wolf, 1994). Researchers have long noted that most adoption and diffusion problems involve people and organisational issues. ‘Technical problems seldom account for …failure’ (Anderson and Schroeder, 1994). Reinforcing this view that technology diffusion is significantly influenced by people and processes, Kai-ming and Enderwick (2000) argue that the cognitive process, which help determine attitudes towards technology adoption, “was found to be affected by the six beliefs of compatibility, enhanced value, perceived benefits, adaptive experiences, perceived difficulty, and supplier commitment.”

Significantly for the industrial marketer, failure on the part of the adopter to realise continued market success from the technology ‘purchase’ brings with it a likelihood that future purchasing decisions will include competing product options. Thus, in practice, successful technology diffusion necessitates close involvement with customers and market networks, and again, prompts the question: *what is marketing’s role in technology diffusion?*

Importantly, firm technology transfer effort can now be conceptualised as four distinct stages, with each stage having quite significant implications for marketing’s role. The conceptual framework, and its relationship to the primary research question, is presented as Figure 2-9:

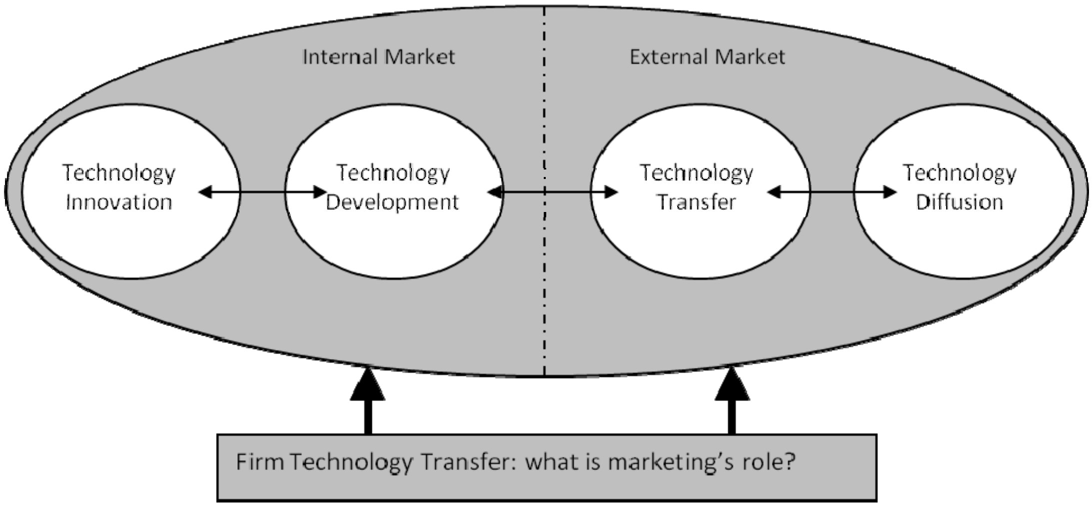


Figure 2-9: A Conceptual Framework for Firm Technology Transfer

2.20 Summary: Themes in the Technology Management Literature

Reviewing the technology management literature revealed a number of themes, with each theme pertinent to the conceptual framework. These themes are presented in Figure 2-10, below. What was of particular interest to the study was that, in addition to theory and practice both placing importance on technology transfer for firm value creation, each of the themes are reflected in industrial marketing practice, and as such help bridge the gap between technology management theory and marketing practice.

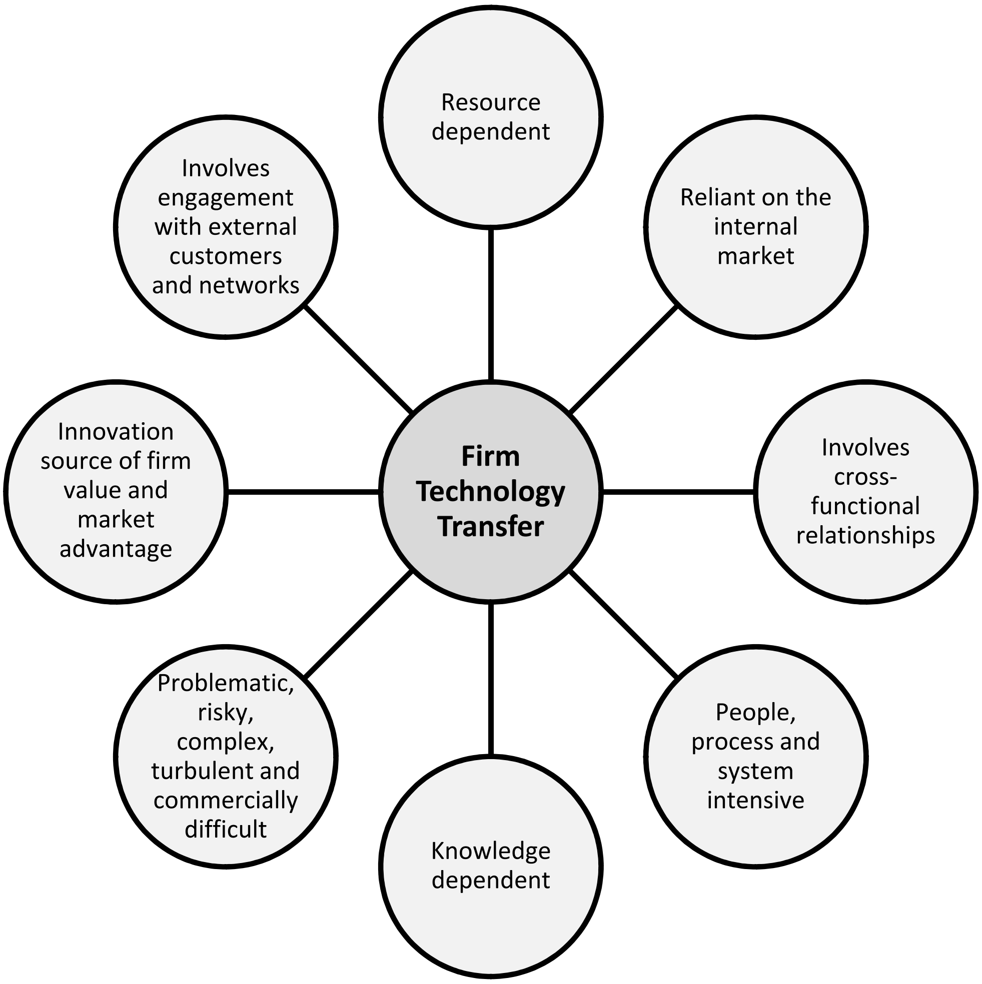


Figure 2-10: Themes in the Technology Management Literature

Theme Four: The Rise of Knowledge as a Source of Competitive Advantage

The importance of firm 'knowledge' is now well established in the management literature, although it's potential to generate firm value is less well developed. Nevertheless, many studies show that knowledge is considered an important firm resource, because it is unique, inimitable, and valuable (Ahmed Lim, and

Zairi, 1999; Civi, 2000; Day and Wensley, 1988; Kitchen et al., 2002; Prusac and Davenport, 1999).

2.21 Knowledge as a Source of Competitive Advantage

Historically, firms have derived value (margin) from the more traditional notion of transforming goods from raw materials to production and eventually to end customers. Challenging this convention however, scholars now report new opportunities to create value from knowledge (Massey, Montoya-Weiss and Holcom, 2001; Nonaka and Takeuchi, 1995). Technological knowledge, in particular, has become a vital element in this discourse on the basis that it underpins technology development - one of the principle drivers of competition – and can thus pave the way for new commercial opportunities and bring the firm market advantage. Thus theory suggests that technological knowledge acquisition and exploitation is becoming a way for firms to more acutely differentiate themselves in the marketplace.

While 'knowledge' is not a new construct, the concept of *knowledge management* is however an emergent theme within the discipline of business management (Massey et al., 2001). Within this discipline, the literature increasingly suggests that the current 'knowledge based' environment necessitates a paradigmic shift in the way firms approach external (and internal) market opportunities. The proposition here is that, in the current environment, knowledge has become an essential asset and can 'determine the profitability of technology–intensive enterprises' (Borg, 2001; Freeze and Kulkarni, 2007).

This thinking has led to the view that knowledge and information can now be marketed to potential customers separately from the products or services that are based on the application of specific knowledge. In this way, Borg (2001) argues that "developing the market value of knowledge independent of current production is essential to business development" (p. 515). Moreover, where the firm can identify technology-based products and services, the internet now allows for global networking and ultimate delivery of the technological knowledge – in turn generating new network contacts and market opportunities. In theory, there is thus an opportunity for firms to identify the uniqueness of their knowledge and then identify relationships and networks that value their knowledge.

The literature also distinguishes between 'knowledge', 'knowledge management', 'intellectual capital' and 'knowledge capital', although in the main, these concepts are understood to be interwoven. Nevertheless, various types are characterised. For example, Saint-Onge (1996) distinguishes 'tacit' from 'explicit' knowledge, suggesting that explicit knowledge is the knowledge that can easily be captured and shared artificially through manuals, standard operations and job processes, whereas tacit knowledge is the skills and know-how that we have inside of us that cannot easily be shared.

Stewart (1991) defines knowledge as intellectual ‘material’ relating to information, intellectual property and experience, that can be put to use (i.e. through marketing) to create wealth. Edvinsson and Sullivan (1996) classify intellectual capital into human and structural capital, distinguishing between “thinking” and “non-thinking” assets. In conceptualising knowledge as an asset, Rogers (2003, p. 182) defines three distinct types:

1. Human: attitudes, perceptions, and abilities of employees; and their motivation commitment and adaptability to the company
2. Organisational: intellectual property such as brands, copyrights, patents and trademarks; and infrastructures including culture and process capability
3. Relational: knowledge of and acquaintance with communities, competitors, customers, governments and suppliers in which the company operates

Other scholars (Edvinsson and Sullivan, 1996; Roos et al; 1998; Saint-Onge, 1996; von Krogh and Roos, 1996; Bontis, 1998; Roslender and Fincham, 2001) view knowledge as:

1. Residing in people: competencies, knowledge, know-how and experience
2. External to the firm: constituencies and structures such as links to customers, suppliers and other stakeholders and networks

3. Contained internally in the firm: organisational structures, routines, processes, and management systems

In sum, the literature reports knowledge as being tacit and explicit, and that it can reside in individuals, or collectively as an asset for the firm. The significance for this study is that ‘firm knowledge’ is increasingly theorised as having potential to add value, with knowledge able to provide new-to-the-firm product and service opportunities, in addition to new application opportunities for firm technological knowledge outside traditional markets.

It is argued that knowledge has, in theory, become a *marketing* resource, and that in the new economy, knowledge resources can represent a new and expansive potential for revenue generation. In this context, Drew and Coulson-Thomas (1996) suggests that opportunities “abound” to create revenue by packaging and applying information and knowledge, offering information and knowledge based services, and managing intellectual capital more effectively. Moreover, identifying and promoting firm knowledge assets can be viewed as a critical component of technology innovation, technology transfer and value creation. Supporting this view, many scholars now suggest that knowledge - not labor and capital - is becoming the lifeblood of business, and where other assets are subject to diminishing returns, marketing strategies formed around ‘knowledge’ can enhance the firm’s competitive position and open up new paths to profitability.

As previously mentioned, while *management* of firm knowledge is as yet an undeveloped area, academics are increasingly reporting that firms who direct their efforts toward exploiting knowledge assets will find opportunities to create wealth above and beyond the management of traditional physical assets (Bean et al., 2002). In this context, exploiting technological knowledge can be considered a technology-transfer process which to a large extent is dependent on how the firm manages innovation ‘knowledge’ within the internal market, and then develops and transfers this technological knowledge into external markets.

The idea that the firm’s knowledge and capabilities can be ‘exploited’ is not new for management scholars. For example, Day et al., (1988) interweave competitive advantage with the concept of the market driven organisation, and link ‘internal conditions, marketplace capabilities and process factors as simultaneous drivers of competitive advantage’. Similarly Ghingold and Johnson (1998) describe these business-level capabilities as a ‘complex bundle of skills and knowledge that lead to superior asset utilisation and/or customer service’ with the knowledge component a ‘major factor driving business level capabilities’ (p. 70). A more direct role for technological knowledge has been presented by Day (1994), who contends that intra-firm technical knowledge ‘is a necessary condition that enables the market driven firm to respond to market conditions in order to create and sustain competitive advantage’.

For marketers, profiting from environmental technological change may now require closer attention to firm knowledge potentials. The suggestion is that understanding, developing and promoting the firm’s knowledge ‘stocks’ and technological capabilities and competencies should now become a key element in firm market planning. Of course the difficulty for the practitioner, in supporting the idea that ‘knowledge assets’ can potentially provide the firm with marketable (read: profitable) products and services, is the requirement for other members of the firm to similarly accede. As such, marketing resources could become pivotal in transferring firm ‘technological knowledge and capabilities’ to perceived (read: researched) market needs. For the marketer, the firms collective technological knowledge (tacit and implicit), in addition to existing products and services, thus becomes a ‘product generator’ in the sense that firm (technical and marketing) knowledge may be flexibly (i.e. different knowledge ‘mixes’) adapted and promoted to traditional and non-traditional customers and networks. In this way, the firm has in theory, an endless supply of product and service opportunities that cannot be easily imitated by competitors. Notably, a recent study of “Knowledge Effectiveness, Social Context and Innovation” (Brachos, Kostopoulos, Soderquist and Prastacos, 2007) comprising 72 ‘business units' across three industry sectors, reported that when pursuing technology transfer, "motivation to transfer knowledge" is crucial for fostering knowledge transfer and innovation" (p. 41).

Again, the literature points toward a number of developing themes for marketers, each of which are of particular importance to this study. Firstly, the marketing environment has changed in terms of blurred sector boundaries and the ease by which firms can have access to global markets and networks. Secondly, firm technology innovation and technological knowledge is increasingly becoming the 'means to production' as it were – allowing firms to develop new products and new markets. Thirdly, as a result of technological change, new product and process technologies are constantly being introduced, and thus relationships with suppliers, customers and competitors are undergoing constant change.

The challenge for marketers here is that promoting firm technological knowledge in order to generate firm competitive advantage requires internal and external marketing relationships. As has been noted, internal markets are not generally categorised in the literature (or in practice) as unified in working toward firm market(ing) objectives, and external markets cannot be engaged without some form of business-to-business relationship development. For the purposes of this study, it is theorised that marketing is well placed to have a greater role in identifying and promoting inter-functional relationships as a necessary precursor to developing firm innovative capacity and technological knowledge. Further, it is also argued that marketing must now look to identifying and fostering new (read: non-traditional) external customer and network relationships so as to enhance firm technology transfer and diffusion potential. In this context, the question for this study thus becomes: *what is the role for marketing in promoting internal and external market relationships in order to promote firm technology transfer potential?*

2.22 The Internal Market

The actual concept of the 'internal market' (and 'internal marketing') became part of marketing language during the 1980s, finding its way into practice as a result of (distant) research in the service sector - much of which was directed at the mechanisms by which 'services' were delivered. During this time scholars began to challenge normative understanding of what it was to be the 'customer' and began to apply the concept within the context of the firms 'internal' market. Now other members and functions could be perceived as 'internal customers', embracing the idea that by 'serving' (read: meeting their needs) other firm members better enabled *their* ability to meet external customer needs. Thus in theory, this service orientation assisted the firm to become more customer focused, although to be effective it required the firm's employees to be 'motivated and customer conscious' (Gronroos, 1981).

The importance placed on the internal market is by now well established in the marketing literature with a rapidly growing body of work concerning the concept of internal marketing, what it is, what it is supposed to do, how it is supposed to be done, and who is supposed to do it' (Ahmed and Rafiq, 1995, p.32). Vary (1995) cites Helman and Payne (1992) who suggest that 'internal marketing was originally proposed as an approach to service management which entailed application of the traditional marketing concept and the associated marketing mix *inwards'*. In this context, internal marketing is thus a mindset of considering employees as part of the customer base of a company, although, consistent with the author's experience, the literature suggests very few firms actually apply the concept in practice.

During the later half of the 1980s and into the 1990s, the need for improvement in firm internal capability to deliver 'valuable customer service' continued to receive widespread attention (Christopher, Payne, and Ballantyne, 1991; Grönroos, 1991; Wilson, Gilligan, and Pearson, 1992) having evolved to include employees as service providers to each other in addition to service provision for external customers. For Varey (1995), this service-centered business 'philosophy' generates competitive advantage “through the mobilisation of the accumulated know-how of individual employees to create value (*or value propositions*) for customers through processes (service activities) which are not easily imitable” (p. 40, italics the author’s). A decade on, these concepts of ‘internal market’, ‘service provision’ and ‘knowledge’ contained in Varey’s (1995) review of challenges facing internal marketing researchers continue to have implications for practitioner effort and is a focus of this study. In practice, the marketer now operates in two marketing domains (internal and external), can (at least in theory) influence increased *external* customer service through marketing emphasis on *internal* customer service, and, perceptibly, can more readily access the knowledge and ‘know-how’ of individual employees and functional groups. This is important, because for the marketer it is technology and technological knowledge that can purportedly provide the firm with competitive advantage, and it is service and relationships that can enable technology development and transfer of this knowledge.

Reinforcing this idea, Ballantyne (2003) argues that ‘knowledge’ is ‘widely distributed among organisational members (p. 1245), and further suggests that intangible knowledge (i.e. market & technical) can provide the firm with a source of competitive advantage through application of the knowledge required to innovate, develop and transfer new technology products. Ballantyne (2003) also suggests that internal marketing requires a ‘relationship-mediated’ approach, and that “internal marketing can be defined as a relationship development strategy for the purposes of knowledge renewal” (p. 1242).

Internal marketing is also viewed as a ‘management approach’ that enables and motivates members of the organisation to adopt a customer consciousness and service orientation, whether ‘front line’ service performers or ‘back office’ service support workers, to meet the needs of external customers (Cowell, 1994; Varey, 1995). Peck (1993) and Walker and Ruekert (1987) have also provided discussion around ‘internal marketing thinking’, and point out a tendency towards viewing internal marketing in the context of ‘territorial’ or cross-functional claims. They point out that marketers may have different roles in different parts of the organisation which should be market driven (i.e. responsive to customers) but not necessarily marketing-driven (i.e. controlled by marketer’s using marketing tools).

Arguably, a developing theme in the literature concerns the need for the marketing manager to stimulate organisation wide internal market(ing) orientation, with the aim of identifying and satisfying employee needs through service provision to each other and to the external customers as a way to create competitive advantage. It does appear however, that much of the theory development so far is somewhat 'embryonic' given continued discussion as to what internal marketing actually is, its role, and how it can be implemented (Varey, 1995). Indeed, Varey and Lewis (1999) suggests that internal marketing is 'one area that should receive considerable attention over the next five years', with 'considerable evidence that a 'thorough reconsideration of the depth and breadth of the conceptual basis of internal marketing is required' (p. 929).

Notably, the literature does not provide a clear link between the role of marketing and that of securing organisation wide customer focus (Ahmed and Rafiq, 2003a). Not surprisingly therefore, marketing scholars continue to contend that, as a discipline, marketing has passed up the challenges of a collaborative role within internal markets (Ballantyne, 2003; Marshall, Baker, and Finn, 1998; Varey and Lewis, 2000), underscoring the relevance of this study.

Further, the literature also reveals that while the service quality requirements of external customers have been the focus of much research (Parasuraman, Zeithaml and Berry, 1985), the same cannot be said in regard to studies concerning the service requirements of internal customers. Marshall et al., (1998) report that studies into service quality have focused primarily on consumer markets, not business-to-business markets, and more particularly, assert that 'internal service quality is one of the most important and least understood concepts in modern business' (p. 381), yet "there is little systematic work on how internal marketing actually works in practice" (Ahmed et al., 2003, p. 1221). In effect, the "how" of inter-functional coordination remains relatively under researched (Gray and Hooley, 2002).

This too, is important for this study because, as the literatures of technology management *and* marketing suggest, the 'internal market' is an important aspect of firm technology development and transfer. Indeed, both literatures suggest that internal marketing and inter-functional (read: technical and marketing cooperation) relationships are important to generate firm technology product and technological knowledge, and that it is customer knowledge and relationships that provide the impetus for the firm technology value proposition that can enable technology transfer (read: commercialise). The difficulty here is that the "integrative role of marketing is not widely practiced, and this is why internal marketing is needed to develop the integration based on understanding of the relationship of the organisation's working practices to the external environment" (Varey et al., 1999, p. 929).

Theme Five: The Evolution of Business-to-business Relationship Management

Marketing as a body of knowledge has always been concerned with understanding relationships between suppliers and their customers, although it was not until the 1980's that the 'relationship marketing' concept began to receive widespread academic attention. Arguably, the concept came to prominence through such management researchers as Berry, Shostack, and Upah (1983), Grönroos (1990), McKenna (1985) and Morgan and Hunt (1994), although earlier attempts to formulate a general theory of marketing (Sheth et al., 1988) had already included a *relational* perspective (Aijo, 1996).

2.23 Relationship Management

In practice, the concept of relationship marketing first appeared in the maturing service industries of the 1970s and 1980s during which time the 'transactional' approach to value exchange was replaced by a 'service' oriented approach that emphasised no separation between production, delivery and consumption and the importance of close and enduring customer and network relationships. Explanations are put forward that traditional or 'transaction' marketing is focused on a single sale in the short term, while relationship marketing is focused on customer retention over the longer term. Transaction marketing is said to be oriented towards product features with low service emphasis, and involves moderate customer contact and limited customer commitment. In contrast, relationship marketing emphasizes product benefits with high service, customer contact, and customer commitment (Aijo, 1996; Pels, 1999; Tzokas, Saren, and Brownlee, 1997).

Another view of relationship management is offered by Grönroos (1991) who argues that transaction and relationship marketing differ in their 'time perspective, price elasticity, the dominating marketing function and quality dimension, measurement of customer satisfaction, the customer information system, functional interdependence, and the role of internal marketing' (p.9). For Grönroos (1996), this perspective has taken marketing to the point where it is described simply as the 'process of managing relationships' (p. 11), and 'marketing is seen as relationships networks and interaction' (Gummesson, 1994, p. 2).

While the concept of relationship management has been alternatively described as a 'management fad', a 'paradigm shift', and a 'school of (marketing) thought', the increased attention it now gets from management scholars across almost all management disciplines is testament to its continued importance to theorists and practitioners alike. Indeed for many scholars, the focus on relationship management has created a shift in the way marketing is being organised and practiced, and in turn is 'challenging the traditional view of the marketing discipline' (Morgan and Hunt, 1994). For these scholars, a new paradigm of thought has emerged where marketing success lies in the development and management of relationships that 'extend beyond final customers to include suppliers, channel intermediaries, and a variety of other market contacts' (Kotler, 1992; Webster, 1992). According to Sheth et al. (1988), the 'interest in, and emphasis on relationships is likely to redefine the domain of marketing'. Examples of these marketing relationships and network potentials are illustrated in Figure 2-11.

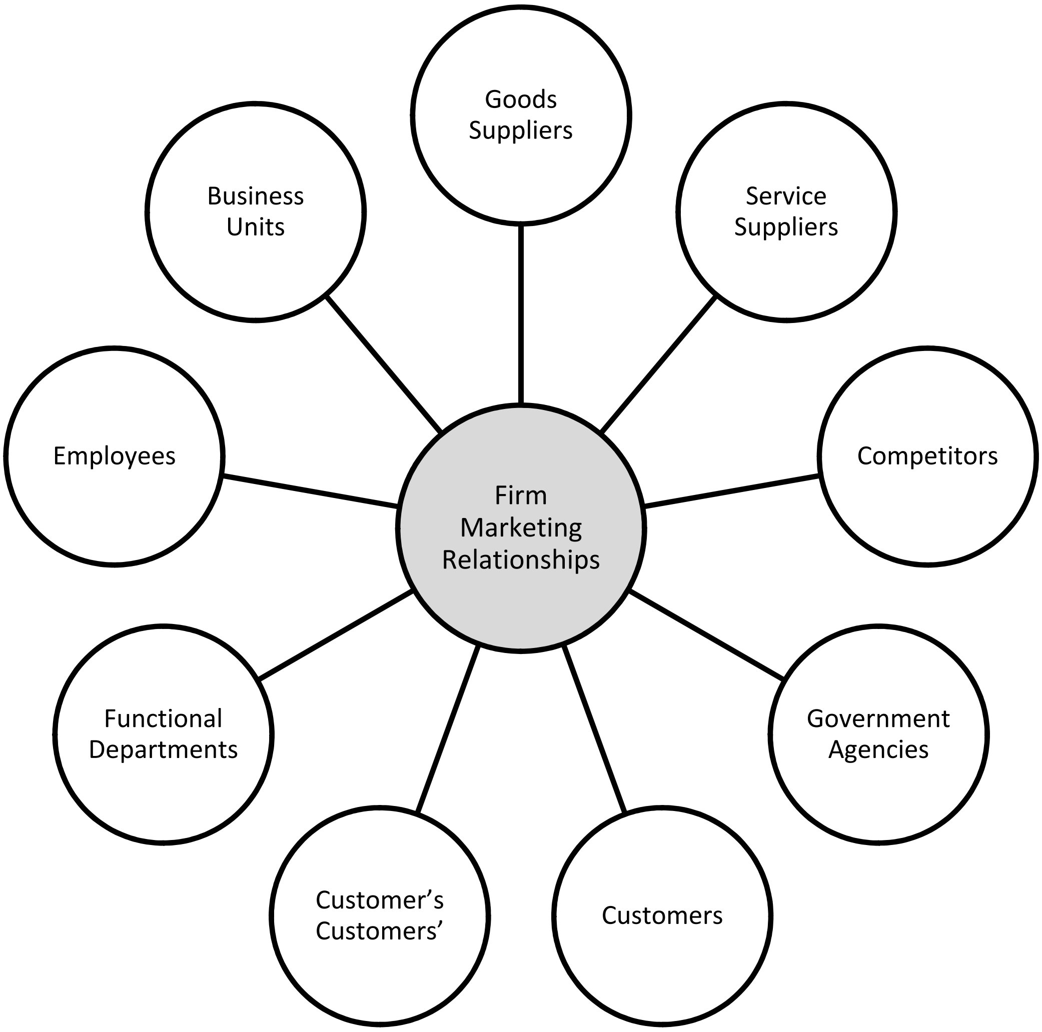


Figure 2-11: Sources of Marketing Relationships and Networks

In this study, relationships and relationship management are perceptibly important parts of the conceptual 'mix' in determining marketing's theoretical role in technology transfer. Inter-functional relationships are shown to be important for firm innovation and technology development, and inter-firm relationships are required for successful technology transfer and diffusion to external customers and networks. Moreover, in practice it is impossible to build a firm technology value proposition without ‘management and integration’ of multiple inter and intra-organisational relationships. Indeed, a unique aspect of relationship management lies in the fact that it acknowledges the significant role of the customer in the value creation process and that relationships that are deemed successful often involve co-operation and co-ordination, rather than ‘mere’ value exchange (Christopher and McDonald, 1995; Grönroos and Ravald, 1996; Ritter, Wilkinson, and Johnston, 2004).

This point is of particular interest to this study: firstly because, in the new environment, knowledge transfer has increasingly become a feature of firm business development, and when the customer is conceived as a co-producer, the interaction between the parties can generate more value than the traditional transaction process (Gardner, 2000; Wikstrom, 1996). There is also the opportunity to gain access to information about common needs, aspirations and plans, which in turn can provide substantial competitive advantage by strengthening strategic co-operation (Wagner and Hoegl, 2006; Zineldin, 2004). It is thus postulated that closer relationship with external customers and networks will create opportunities for the firm to acquire technological knowledge, enabling the firm to better meet customer technology 'needs' and 'service' requirements. Thus it is no longer a question of creating value for the customer; rather it is about creating value *with* the customer *and* incorporating the customer's value-creation objectives into the firm's value proposition. Indeed it could be said that effecting technology transfer requires the development of 'win-win' relationships between the firm and its customers.

Secondly, despite many reasons that have been provided for the emergence and importance of relationship management, there is little discussion about changes in the market environment and their potential direct effect on the practices of relationship management. Because business is now conducted an era where intangible assets such as technological knowledge have become important, it is reasonable to expect that it will affect the way that network relationships are conducted and managed. Further, it is suggested that promoting organisational technology transfer now requires (new) innovative marketing approaches that, for example, see marketing as a conduit for firm internal and external relationships as part of developing and promoting firm technological potentials. In essence, it is argued that marketing's involvement in firm relationship management should now be a critical part of marketing's 'mix' of activities. In this way, relationship marketing becomes a fundamental strategic issue concerned with intra-organisational relationships and inter-organisational alliances (Bean et al., 2002; Piercy and Cravens, 1995).

2.24 The Service Orientated View of Marketing

While business scholars and practitioners are aware that competitive advantage can be enhanced through service (Karmarkar, 2004) and that there is a link between competitive advantage and superior performance (Hunt and Morgan, 1995b), paradoxically, “managers though motivated to perform and aware of the links between service, competitive advantage and firm performance, often fail to execute on that knowledge” (Lusch et al., 2007). And additionally, academics, though also aware of these links “have not sufficiently informed normative theory to adequately assist in that execution” (p. 5.)

For Lusch et al (2007), the central problem is that there is not a full and adequate understanding of the concept of “service” and its role in exchange and competition (p.5), and that the *service concept* and its relationship to ‘exchange, markets and enterprises’ requires the entire organisation to view and approach both itself and the market with a ‘*service dominant (SD) logic’*. Lusch et al (2007) characterise S-D logic as being:

> “…based on an understanding of the interwoven fabric of individuals and organisations, brought together into networks and societies, specialising in and exchanging the application of their competencies for the applied competences they need for

> their own well being. It is a logic that is philosophically grounded in a commitment to collaborative processes with customers, partners, and employees; a logic that challenges management at all levels to be of service to all the stakeholders; a logic or perspective that recognises the firm and its exchange partners who are engaged in the co-creation of value through reciprocal service provision" (p.5).

These authors argue that S-D logic can be traced back through marketing's evolution, which purportedly began with a 'goods-dominant (G-D) logic' that viewed units of output as the 'central components of exchange'. In this context, marketing was viewed as transferring ownership of goods and their physical distribution, although after 1960 practitioner and theoretical focus evolved from 'product (matter) orientation' to 'consumer orientation'. This evolution in marketing is represented in Figure 2-12.

Figure 2-12: Evolution of Marketing
(Source: Lusch, Vargo and O'Brian, 2007, p. 7)

Essentially then, S-D logic advocates viewing the customer as an operant resource – 'a resource that is capable of acting on other resources, a collaborative partner who co-creates value with the firm - and promotes a market with philosophy' (Vargo et al., 2004).

This is important to this study because, in practice, organisational competitive advantage is increasingly based on managing processes that facilitate innovation activity and the commercialisation of technological knowledge. Now, where practice requires fostering and developing the marketing concept within the internal market in order to instigate and integrate firm marketing effort, then the suggestion is that marketing's theoretical 'operant resources' e.g. the firm's internal market - and by extension firm innovation and technological knowledge potentials - should become an important factor in firm marketing effort. In effect, the application of marketing resources promotes development of firm internal and external network relationships which, in theory, stimulate development and transfer of firm technologies and technological knowledge.

In this context marketing's role can be viewed as more than simply uni-directional flows of 'marketing information', but rather as collaboration between marketing and its internal customers. Lusch et al. (2007) describe this collaboration as 'service flows' in which the service is provided directly or indirectly through an object or product. Again, as with practice, marketing service provision to external customers moves from ‘managing’ customers and networks to one of ‘dialogue’ and collaboration leading to a value proposition created by both sides of the exchange. A key point here is that, as with the identified themes of a changed marketing environment, the rise of technology and technological knowledge, and increasing significance of networked relationships, so too has the concept of service undergone somewhat of a transformation in its conceptualisation and practical application. The overall theme here is that “applied knowledge and collaboration are the key drivers for firms to more successfully compete through service” (Lusch et al., 2007, p.8).

Section Three: Literature Review Conclusions

2.25 Themes in Contemporary Marketing Theory and Practice

Reviewing the marketing and technology literatures, and comparing and contrasting theory and practice, illuminated a number of interconnected themes that are important to this study. These themes are shown in Figure 2-13, below.

Principally, each of these themes underpins the proposition that marketing theory and practice are undergoing somewhat of an ‘epochal’ change - suggesting that marketing’s role in firm technology transfer could also change. Globalisation and boundaryless markets, the internet and the impact of technology and technological knowledge have altered the business environment, and it now appears that marketing is, in part at least, evolving itself in order to remain relevant. Certainly it is not possible to find solace in the continuing debate amongst and between theorists and practitioners as to *what actually constitutes marketing*. Moreover, the idea that the business environment is challenging the more normative (4Ps) view of marketing is also reinforced in the literature, with the constructs of 'knowledge', 'relationships' and 'technology' perceptibly changing the meaning and application of marketing practice. This is important because the central objective of the study is the illumination of marketing's role within this environment.

Figure 2-13 thus presents a summation of themes from marketing theory and practice, with each theme reflecting the study's intent to reconsider marketing's role in firm technology transfer effort.

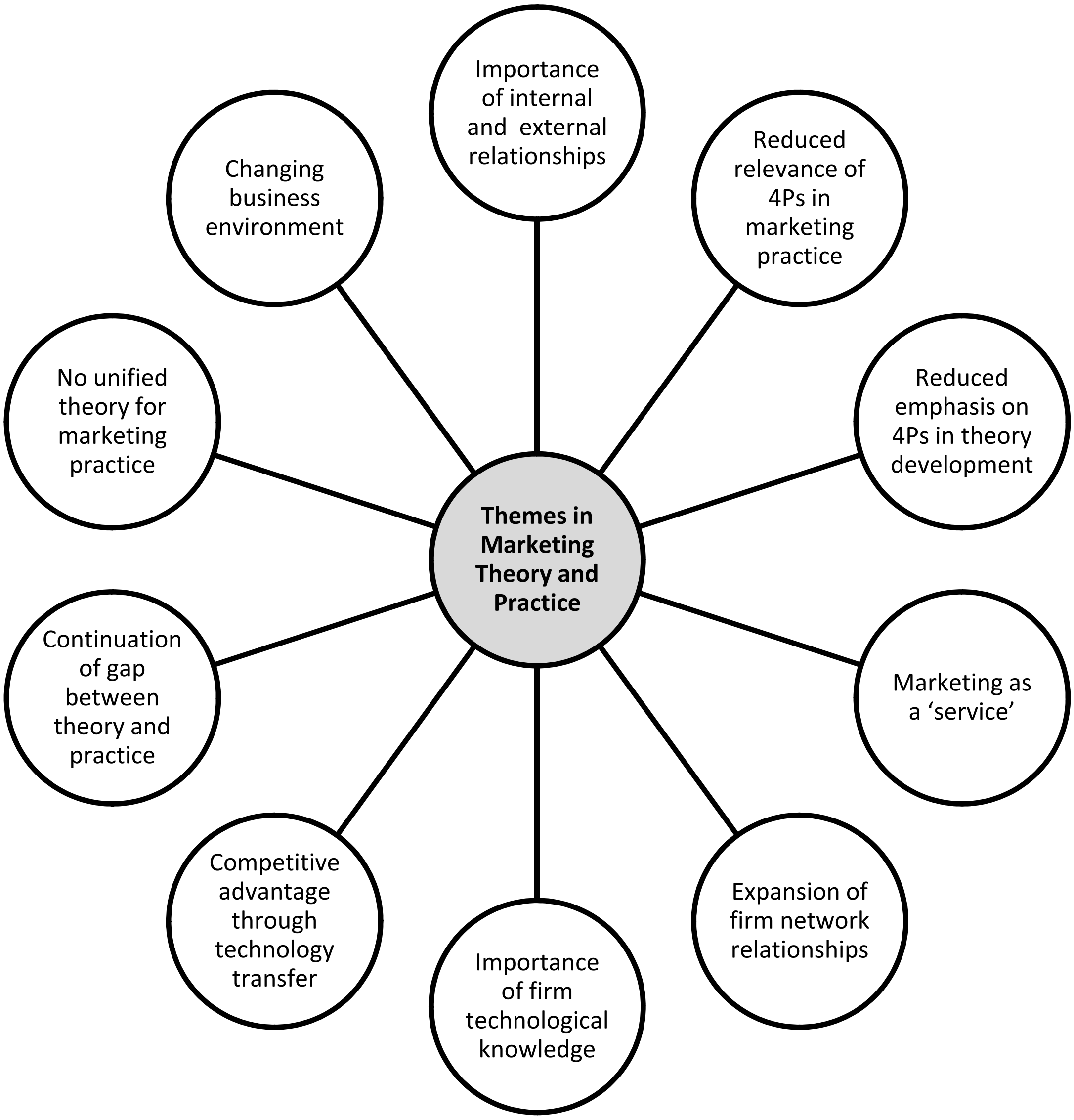


Figure 2-13: Themes in Marketing Theory and Practice

2.26 Themes in Technology Management Theory and Practice

While scholars have put forward many definitions of technology transfer, all share the theme of new product and process development, or new processes and techniques, which are adopted by firms over time. Underpinning these aspects of technology transfer is a view that no firm, however successful, can base future survival purely on past performance. Indeed the literature suggests the need to convert firm ‘experience into knowledge’ and ‘doing into applied knowledge’ (Douthwaite et al., 2001; Drucker, 1993). In this context, firm value creation comes from building technological strength through applying (read: marketing) the firm’s technological knowledge and capabilities.

Thus, if a key objective of marketing is to maximise the value from firm technology investment and technical capability, then the ability of the firm to deploy marketing resources to achieve technology transfer has become crucial. Importantly, this is a concern for marketing management that has been acknowledged for some time (Barksdale and Darden, 1971), and continues to be an under-researched problem (Labahn and Biehal, 1991; Meldrum, 1996).

More latterly, and supported by practitioner experience, scholarship in the marketing and technology literatures suggest that ‘co-operation’, ‘knowledge transfer’ and ‘inter and intra-firm relationships’ are important for firm value creation and competitive positioning (refer Figure 2-13). In this context, literature themes of cross-functional co-operation and internal and external relationship development are viewed as mechanisms for integrating the R&D and marketing functions as a way to overcome the difficulties associated with getting new ideas and technologies transferred and diffused. As postulated by Varey

(1995), an ‘interactive parallel’, rather than a sequential process of new product development is required in order to ‘foster greater co-operation between functional specialists and increased effective communication (information, interaction and dialogue) in order that the likelihood of new product success is increased’ (p.49). The point here is that firm technology innovation, development, transfer, and diffusion effort is more likely to succeed with interaction, co-operation and knowledge exchange between the marketing and R&D functions, and between the firm and its external customers, with these ‘capabilities’ becoming ‘marketing resources’ for firm technology transfer effort.

2.26.1 The Technology Value Proposition: comparing practice with literature themes

Because the study places importance on comparing and contrasting literature themes with practice to better explore marketing’s role, it is therefore useful to compare the marketing themes developed in Figure 2-13 with practitioner experience of the technology ‘value proposition’. The value proposition (as opposed to the 4Ps) has become an *important* guide for marketing practitioners seeking to promote firm technology transfer and is the process whereby the firm’s technology products, services, and technological knowledge are assessed against customer (and network) needs in order to determine the economic value of the technology *to the customer.* In practice, it requires the marketer to identify 'where' the technology has potential application; 'what' business issue (or opportunity) the technology addresses; 'why' the customer will want to pay for the technology (cost / benefit); and 'how' the technology can be deployed within the customer business or network. In short, the value proposition requires that the firm view technology transfer from the customer's perspective, effectively requiring the firm to 'become the customer'.

To be useful, the technology value proposition needs to be specific and precise. It must bear comparison with competing technology alternatives on offer to the target customer. Ideally, it also requires that the firm's functions (technical, market, operational) jointly develop a cross-functional understanding of the issues and opportunities within the customer's business and *their* supply chain. Doing this promotes a solutions based understanding of the customer's value requirements - now and into the future, and quantifies the firm's technology value potential (from the customer's perspective) within that process. Moreover, cross-functional focus on the customer also allows for the development of a value proposition that cannot easily be replicated by competing technology offers, and so doing, helps deliver sustainable competitive advantage and profit to the firm. Importantly, 'becoming the customer' is different than simply listening to the customer. Their 'expressed' wants might only be based on what they think the firm is capable of – not what it *might* be capable of. In other words, the firm may have stocks (resources) of other 'types' of technical knowledge that may be of value to the customer – or the customer's supply chain. In practice this knowledge takes the form of technological resources (i.e. modifying or bundling existing technologies or technical capabilities) and marketing resources (i.e. customer relationships and collaborative opportunities). Indeed, the very development of a technology value proposition provides the firm with unrivalled market intelligence in the form of a first hand and intimate understanding of the customer and their markets and networks – revealing further marketing and innovation opportunities for the firm's technological knowledge.

In many ways the value proposition is unique amongst the industrial marketer's armoury in that, unlike other marketing activities, it requires the marketer to actively pursue cross-functional knowledge of the customers business to better perceive and understand *their* business issues and challenges. In turn, this intimate knowledge of the customer's business can be used to tailor a technology value proposition that more exactly meets the customer's needs. It is also unique in that it requires the customer organisation to 'open up' and allow unfettered access to business activities, people, processes and information, and more often than not, involves a commitment to contributing resources during the evaluation period. In effect, the customer is involved in identifying and quantifying the ‘features’, ‘benefits’, and ‘value’ of the firm’s technological offer. Experience shows that where the customer is intimately involved with developing the value proposition, then ‘sales objections’ are significantly minimised because the customer is involved with ‘identifying and quantifying the technology’s efficacy and commercial potential. In this sense, technology transfer takes place as a consequence of technical and marketing relationships and cooperation, and knowledge sharing (often commercially sensitive) between the firm and the customer.

From the firm’s perspective, the in-customer ‘evaluation’ phase of the value proposition necessitates that the marketer adopt a ‘service mentality’ both toward members of the customer organisation – whose economic position the marketer now seeks to advance, and toward other members of the firm who, because of their involvement in the technology’s development, have a ‘vested’ interest in its transfer and diffusion. In this context, Gilbert and Strebel (1989) argue that an important characteristic of successful firms is their ability to ‘perform simultaneously rather than sequentially’, resulting in market and technical knowledge resources being better distributed and shared within the firm. Piercy (1991) describes the internal market as “strategic” (p. 367) and suggests marketing programs aimed at the firm’s internal market should parallel and match programs aimed at external markets because external marketing strategies imply changes of various kinds within the firm such as resource allocation, and further suggests the role for marketing should be one of 'coordination' across the firm's functional units. Indeed for Ballantyne (2003), marketers 'cannot avoid collaborative relations within internal markets' (p. 1247). The point here is that, for the value proposition to be an effective means of transferring technology products and services, the firm must possess a network of cooperative and collaborative internal and external relationships that facilitate the capture market intelligence so that the firm's technical capabilities can be aligned to the wants and needs of its target customers. In this context, and supported in theory, the firm's internal and external relationships, its customer and market intelligence, and its technical knowledge and capabilities can be conceptualised as marketing resources for technology transfer effort. These marketing resources are conceptualised in Figure 2-14.

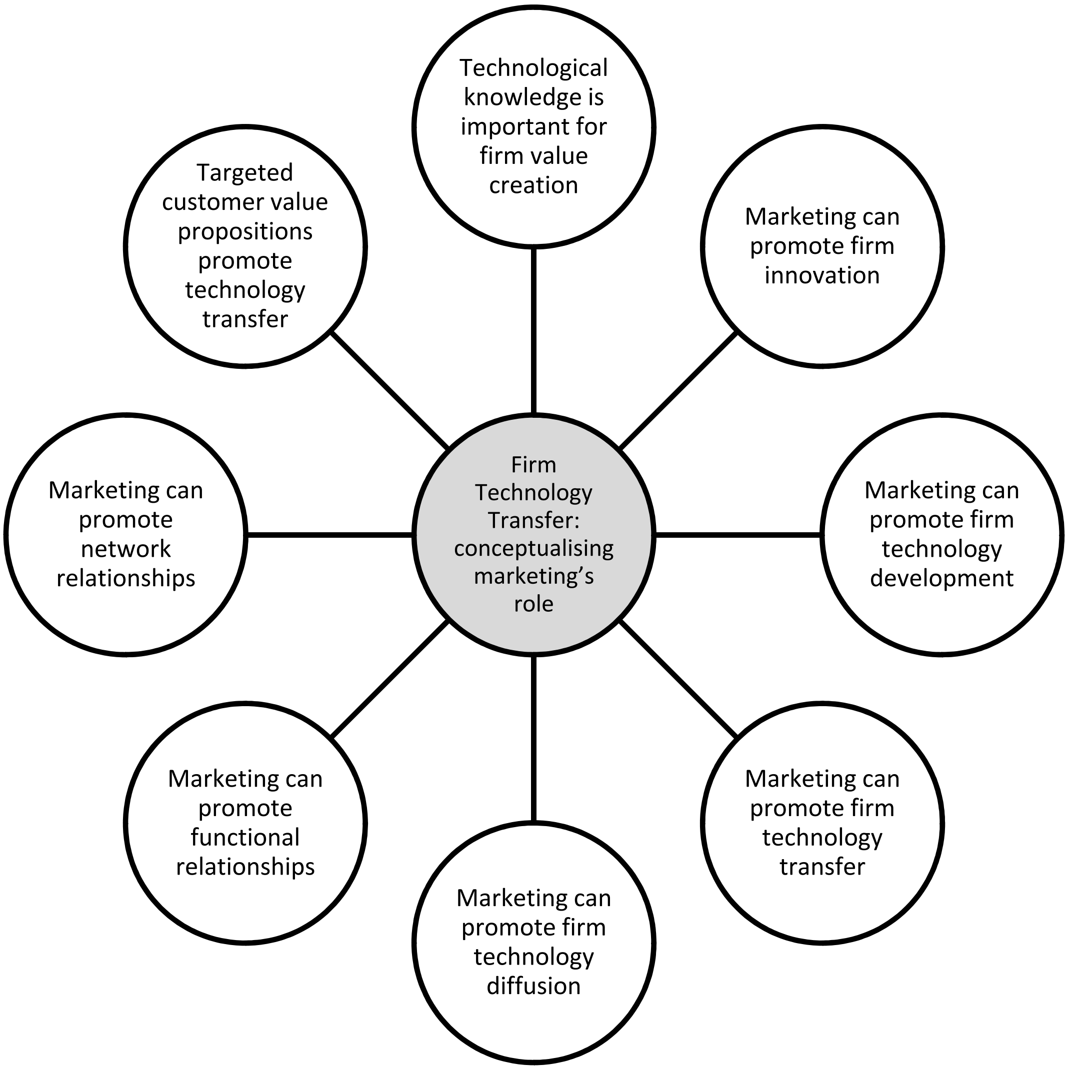


Figure 2-14: Conceptualising Marketing's Role in Technology Transfer: a resource based view

Chapter 3 - METHODOLOGY

'Fortune favours the prepared mind' - Louis Pasteur

Introduction

Chapter Three explains the study's methodological rationale, and justifies the interpretive approach as the paradigm of choice. The chapter also explains and justifies use of the case study method and the various qualitative techniques employed to collect and analyse the case evidence.

For clarity, the chapter is broken into three sections. Section One backgrounds the study's methodological strategy, explains the author's reflexive position, and presents philosophical justification for the choice of the interpretive paradigm and qualitative methodology. Issues of epistemology, ontology and the nature of the qualitative research process are also discussed.

Section Two is concerned with outlining and justifying the method on which this study of marketing and firm technology transfer is based. The intent here is to justify the case study approach, and to describe how various data collection methods were integrated as part of a cohesive strategy to ensure research trustworthiness, authenticity and applicability. This integrative approach is considered important given the need to explore and interpret marketing's role in a changed business environment within the context of differing approaches to firm technology transfer. Section Two also outlines the methods employed during field activities and data collection and analysis.

The third section sets out the case study protocol, a major tactic in increasing the reliability of case study research (Yin, 1994), and describes the procedures and general rules that guided the researcher during the *Case* study.

Section One: Developing the Methodology

3.1 Background

For the researcher, consideration of an appropriate research strategy for this study presents a number of methodological challenges, with each of these challenges relating to a need to make sense of the complex and varied nature of industrial marketing (however it is conceived), the difficulties associated with firm technology transfer, and the indeterminacy of marketing theory and practice. Effectively, the methodological question related to selecting an appropriate strategy from which to construct theoretical knowledge about marketing's role in a changing social world, and to determine how data would be collected to test this construction.

In this regard, a number of aspects influence methodology selection. Important among these was the need to acknowledge that the firms under study were owned by the New Zealand Government. Despite their ownership status, the

'Crown Research Institutes' (CRIs) are however focused on R&D, technical innovation, and technology transfer. They also operate as independent commercial entities, often in competition, have a separate boards, management teams, technical focus, and strategic intent. In this sense, the CRIs are considered within the context of industrial firm technology transfer, which had become a moderator variable, and as such, was the basis for theoretically relevant comparisons with privately owned R&D firms. The CRI is considered therefore to be an ideal case study given the intent of the research to illuminate marketing's role in industrial firm technology transfer.

Important also was the opportunity to utilise the researcher's access to these CRIs. This included unfettered access to executive teams, functional groups, business plans and internal company records. Thus, because the study is motivated and influenced by the firsthand experience of the 'researcher as practitioner', consideration of 'reflexivity' and the researcher's reflexive position is essential.

3.2 Reflexivity

Qualitative and interpretive research usually operates from the premise that total detachment on the part of the researcher is unobtainable (even if deemed desirable) and that the researcher is an integral component of the entire process, as opposed to being an innocent bystander with the capacity to provide an 'uncontaminated' account. Reflexivity refers to active acknowledgement by the researcher that his (or her) own actions and decisions will inevitably impact upon the meaning and context of the experience under investigation. By means of reflexivity the researcher realises that they are an integral part of the world being studied, and that neutrality and detachment in relation to data collection, analysis and interpretation is impossible (Henwood and Pidgeon, 1993; Mason, 1996; Hill and Wright, 2001b).

In this sense, all facts are interpreted facts (Daley, 1997) and that the constructs developed by the researcher are second degree, i.e. they are interpretations made of the constructs of the participants as delivered to the researcher (p. 349). For Daley (1997), the challenge is one of 'preserving participants' definitions of reality' (p.350), whilst concomitantly developing a theory which transcends these. Theory is, by definition, imposed upon the interpreted data, the role of the researcher being '…to organise, select and construct explanation' (p. 350). While this may appear obvious, Daley (1997) points also points out that:

> Although there is greater acknowledgement of the role that the self plays in the research process, the self is usually left out of the final theoretical product of the research endeavour…For all intents and purposes, the theory…is presented as the product of a disembodied intellect (p. 351).

Guba and Lincoln (1995) also contend that findings are not facts *per se*, but are created via the interaction of the participant, the data, the researcher and the evaluator. As such, they are dependent upon the value systems of each party and the context within which they operate. This point is also made by Sandelowski (1993) who states that two researchers faced with the same qualitative task will produce different accounts due to their individual philosophies and theoretical commitments. Sword (1999) also agrees with this proposition, and suggests that while some might criticise the subjectivity that is inherent in interpretive work, 'no research is free of the biases, assumptions, and personality of the researcher'. The researcher is thus 'not able to separate self from those activities in which they are intimately involved' (p. 277).

3.3 The Researcher's Reflexive Position

Apart from acknowledgment that the researcher is part of, and is influenced by, the world being studied, recognition of the researcher's experiential understanding is also important in the development and interpretation of qualitative data (Gilmore and Carson, 1996). The suggestion here is that the experiential nature of qualitative research *combined* with the researcher's experiential learning may permit deeper understanding of the phenomena as the research evolves, thereby building on earlier work.

Because it is acknowledged that the author is intimately involved in both the process and product of this study, it is necessary to identify and explicate other areas of involvement and their potential effect upon the findings. It is also expedient to identify and place in context the role of the researcher operating as practitioner within the *Case*.

Since 1992 the researcher has been employed as a marketing and general manager in a number of New Zealand and Australian industrial firms. As part of each job profile, it was necessary to engage with external customer research and development, and with networks associated with this activity. For the researcher, this facilitated development of a network of working relationships with CRIs[7], and other R&D firms operating across multiple industry sectors. With the apparent divergence of views as to what constituted marketing, and with the all-to-apparent difficulties experienced (and subsequently confirmed in the literature) by firms engaged in technology transfer, the author became interested to conduct PhD research in this perceptibly under-researched domain – that is, marketing’s role in firm technology transfer.

[7] Nine CRIs were established in 1992 as government owned businesses with a scientific purpose. Each institute is based around a productive sector of the economy – although theses ‘sector’ demarcation lines are now blurring.

Benefiting from a relationship with the chairperson for the Foundation for Research Science and Technology[8] (FRST), the researcher was contracted by FRST to examine and report on the technology development and transfer status of CRIs as part of an exercise to gauge technology transfer capability. Ultimately, these CRIs became the focus of this study (the *Case*), and the FRST project provided the resources for an extensive data collection phase. More latterly, and during the course of the study, the author has been employed by two CRIs[9] to develop firm marketing functionality, and assist in technology development and commercialisation effort.

3.3.1 Implications for the study

During the process of the study the researcher had unrestricted access to multiple industrial firms, and their personnel, processes, business plans, and archival material. This allowed the researcher to observe and gather detailed impressions and descriptions of technology transfer and marketing effort and facilitated cross-functional interaction and relationship development with individuals and teams. This first-hand experience of firm technology transfer

[8] FRST was established by an act of parliament in 1990 to invest in research, science and technology for the benefit of New Zealand.

[9] These CRIs include the Forest Research Institute (subsequently changed to 'Scion'), and the National Institute of Water and Atmospheric Research (NIWA).

effort during the process of the study thus allowed the researcher to interpret marketing's role from the perspective of the 'researcher as practitioner', and given the network of relationships connected to the study, from the perspective of the customer and supplier. The proposition here is that the author's reflexive position provided a unique opportunity for rich description of the phenomena under study in its natural, behavioural, organisational, and network context. Indeed this research context, which takes account of the individual, the firm and its network, and that of the researcher, provides the methodological 'capability' required to develop a holistic view of marketing's role in technology transfer. This is a key objective of the study.

3.4 Developing a Methodological Strategy

Research methodologies are generally informed by specific paradigms, yet there is usually more than one way to make sense of an observed pattern in a way that can suggest other possibilities. Put another way, different points of view yield different explanations for the same phenomena. In this way, it is an important consideration for any researcher to choose a methodological position from which to conduct their research. At the same time, developing a strategy of inquiry also connects the study to specific methods of collecting and analysing empirical materials. These methods and their application are described in Section Two.

In academic enquiry, choosing a paradigm is described as accepting a 'set of basic beliefs' – or first principles – in order to guide the study and define the worldview of the researcher (Denzin and Lincoln, 2000, p.157). These principles combine beliefs about ontology (what is the nature of reality?), epistemology (what is the relationship between the enquirer and the known?), and methodology (how does the researcher gain knowledge of the world?) (Guba, 1990, p 18). These theoretical 'perspectives' are put in context by Healey and Perry (2000) who describe ontology as the 'reality that researchers investigate', where epistemology is the 'relationship between that reality and the researcher'.

Effectively, these beliefs shape how the researcher sees the world and acts in it, "binding the researcher within a set of epistemological and ontological premises which – regardless of ultimate truth or falsity – become partially self validating" (Bateson, 1972, p. 314). For Guba (1990), these premises - or 'beliefs'- containing the researcher's epistemological, ontological, and methodological premises may be termed a paradigm, or a "a basic set of beliefs that guide action" (p.17). Similarly Kuhn (1970), advocates that, without paradigms, scientific research could not take place as a collective enterprise since 'science needs an organising principle'.

In the main, the literature distinguishes between four major paradigms[10] that structure qualitative research: positivist and postpositivist, constructivist-interpretive, critical, and feminist-poststructural (Denzin et al., 2000, p. 20). It is in understanding the 'tenets' (read: features and benefits) of each paradigm that enables researchers to select a set of guidelines that connect a theoretical paradigm to a strategy of enquiry, and to the appropriate methods for collecting and analysing empirical material, e.g. specific firms, groups, persons, documents and archives. In this way, the chosen methodology specifies how the researcher will address the two critical issues of representation and legitimation.

These four paradigms are presented in Table 3-1, together with the theoretical issues cited as most often in contention.

	Positivist /	**Postpositivist**	**Critical**	**Constructivist-Interpretive**
Inquiry Aim	Explanation: prediction and control		Critique and transformation; restitution and emancipation	Understanding; reconstruction
Nature of Knowledge	Verified hypotheses established as facts or laws	Non-falsified hypotheses that are probable facts or laws	Structural / historical insights	Individual reconstructions coalescing around consensus
Knowledge Accumulation	Accretion – "building blocks" adding to "edifice of knowledge"; generalisations and cause-effect linkages		Historical revisionism: generalisation by similarity	More informed and sophisticated reconstructions; vicarious

[10] While these four paradigms are most often cited, other paradigmic perspectives have emerged e.g. 'Marxist', 'emancipatory', 'post-structural', 'afrocentric' and more recently, 'participatory'.

			experience
Quality Criteria	Conventional benchmarks of “rigor”; internal and external validity, reliability, and objectivity	Historical situatedness; erosion of ignorance and mis-apprehension; action stimulus	Trustworthiness and authenticity
Values	Excluded – influence denied	Included – formative	
Ethics	Extrinsic: tilt towards deception	Intrinsic: moral tilt towards revelation	Intrinsic: process tilt towards revelation; special problems
Type of Narration	Scientific report	Essays, stories, experimental writing	Interpretive case studies, ethnographic fiction
Voice	“Disinterested scientist” as informer of decision makers, policy makers and change agents	“Transformative intellectual” as advocate and activist	“Passionate participant” as facilitator of multi-voice reconstruction

Table 3-1: Paradigm Positions on Selected Research Issues
(Adapted from Denzin and Lincoln, 2000, p. 166)

In this study, the researcher applied three key criteria as a ‘yardstick’ to assess and select a suitable methodological strategy, or position, from which to address the research question. The first of these criteria relate to the researcher’s desire to accommodate the individual (human agency) perspective *and* the firm (social structure) perspective of marketing. Because marketing effort is subjective i.e. influenced by individual practice whilst also being objective i.e. influenced by firm business imperatives[11], the intent here was to develop a holistic view of contemporary marketing – one that reflected both individual and firm motivations so to speak – in order that the study might develop marketing's theoretical role *and* yield some practical application. To achieve this, selection of a methodology that promoted exploration of marketing phenomena from the individual and firm perspective was therefore considered important.

The second concerned the intention of the researcher to be 'intrinsic' in the wider research process – not just as a dispassionate observer and recorder, but also as a facilitator of 'multi-voice reconstructions' of the research setting. This is considered essential because the 'varied' views of marketing encountered by the researcher, outlined in the preceding chapters, may otherwise limit determination of marketing's role in 'cradle to grave' firm technology transfer. Thus, a methodology that enables theory development through ongoing researcher involvement during the process of the study is considered valuable.

The third criterion for methodology selection concerned the researcher's intent to capitalise on knowledge and experience of firm technology transfer effort - the research setting - to *better* enable description of marketing phenomena in its natural, behavioural, and organisational context. The suggestion here is that

[11] The proposition here is that, hermeneutically, individual marketing (activity) can be understood in the context of firm business imperatives (profit).

vicarious experience of innovation, development, transfer and diffusion activities uniquely positioned the researcher to get to the heart (read: coalface) of firm marketing and technology transfer effort. Meeting this criterion thus provides a unique opportunity for reflection and interpretation of actual marketing and technology transfer practices and, indeed, promoted more informed and sophisticated reconstructions of the research setting.

On reflection then, it was considered that the constructivist-interpretive paradigm offered the best methodological perspective from which to both address the research question and meet the primary goal of the study, that is, the exploration, illumination and description of marketing's theoretical role (processes and activities) in firm technology transfer effort.

At this point, it is pertinent to determine what is meant by the 'interpretive' approach because the literature often does not often distinguish between 'interpretive' and 'qualitative' research. In this study, the word 'interpretive' is not a synonym for 'qualitative'. Qualitative research may or may not be interpretive depending on the underlying philosophical assumptions of the researcher (Meyers, 1997). For example, if one follows Chua's (1986) classification of research epistemologies into positivist and interpretive, qualitative research can be done with a positivist or interpretive stance, implying that case study research can be positivist (Yin 1994) or interpretive (Walsham, 1993).

3.5 The Interpretive Paradigm

Interpretivism, generally characterised as the *Verstehen*[12] tradition in the human sciences, arose during the late 19th and early 20th centuries as a response by neo-Kantian sociologists to the then dominant philosophy of positivism. At the heart of the disagreement was the claim that the human sciences were fundamentally different in nature and purpose from the natural sciences. These defenders of interpretivism argued that the human sciences aimed to understand human action, whereas the proponents of positivism held the view that the purpose of science is to offer causal explanations of social, behavioural and physical phenomena.

Arguments advocating interpretivism as a legitimate basis for understanding human activity are well 'rehearsed' in the organisational study's literature[13]. This is not to say, however, that interpretive scholarship has resolved the issue of whether there is a critical distinction to be drawn between the natural and the

[12] *Verstehen* refers to the process of 'interpreting' or 'understanding', also known as the *Geisteswissenschaftlichte* tradition.

[13] See for example Burrell and Morgan, (1979); Putman, (1983); Chua, (1988); Dyer and Wilkins, (1991); Orlikowski and Baroudi, 1991; Walsham, (1993).

human sciences on the basis of different aims - explanation versus understanding – because even to this day, the issue 'remains more or less unsettled' (Schwandt, 1994) in Denzin and Lincoln, (2000). Indeed, the literature points to a "wide variety of [qualitative] scholars who often are seriously at odds with each other" even if they do share a common rejection of the "philosophical anthropology of disengagement that has marked mainstream social science" (p.190).

Notwithstanding this ongoing philosophical debate, the literature does suggest a number of ways that researchers can theorise (read: define) interpretive understanding or *Verstehen.* For example, one way for researchers to understand human action is to 'grasp the subjective consciousness or intent of the actor from inside' (Weber, 1949). *Verstehen* thus entails a kind of 'empathic identification' with the actor in order to understand their motives, thoughts, desires or beliefs (Schwandt, 1994) in (Denzin and Lincoln, 2000, p. 192). A second definition of interpretive understanding is represented in the analysis of action, where each action has its own rules or criteria that make the action meaningful to its participants by virtue of the system of meaning to which it belongs. It is in understanding these systems of meanings (i.e. the action-constituting rules of technology 'stage-gate' systems[14]) that is the goal of

[14] Stage-gating is the practice of providing a continuous and structured focus on technical developments against a defined set of business criteria.

Verstehen (Giddens, 1984). A third way of making sense of the notion of interpretive understanding is through phenomenological analysis, which is principally concerned with understanding how the everyday, inter-subjective world is constituted. The aim for the researcher here is to come to understand 'how social reality – everyday life – is constituted in conversation and interaction' (Outhwaite, 1975, p. 191).

Based on these definitions, it is argued that the constructivist-interpretive paradigm and the researcher's reflexive position fit comfortably together because both presuppose a relativist ontology (there are multiple realities), a subjectivist epistemology (knower and respondent co-create understandings) and a naturalistic (in the natural world) set of methodological procedures (Denzin and Lincoln, 2000, p. 21). Additionally, apart from reinforcing the suitability of the interpretive approach to address the objectives of this study, these definitions all support the ontological view that, while it is necessary to consider how people view their world and to understand what they see as reality, each individual sees the world differently (Creswell, 1994). In this sense, it is suggested that technology transfer reality is that actually constructed by individuals involved in firm technology transfer effort - the research situation. Thus, because multiple realities exist (the researcher, the individuals under investigation, and indeed, the audience interpreting the study), understanding this world, therefore, means that the researcher, as participant, *is able* to represent or reconstruct the world as it is seen by others.

Moreover, from an epistemological point of view, theses perspectives of interpretive understanding also make it possible for the researcher, reflexively, to assume a subjective relationship with the 'actors' through close interaction with the subjects of the study and immersion in the research setting. In so doing, the shared knowledge and social action associated with marketing and technology transfer activities promotes understanding of the subjective meaning of action (the actors beliefs and desires) – *but in an objective manner* (Schwandt, 1994) in (Denzin and Lincoln, 2000). It also makes it possible to accommodate the individual (subjective) and firm (objective) perspectives of marketing – despite the apparent duality of these theoretical positions. This proposition is supported by Lincoln and Guba (2000) who state that

> "Constructivists desire participants to take an increasingly active role in nominating questions of interest for any enquiry and in designing outlets for findings to be shared more widely within and outside the community" (p. 175).

Further, these interpretive perspectives also make it possible to explore and describe marketing *and* objectivise its theoretical role in firm technology transfer effort. Thus, in addition to theory development, practical insights for marketing's 'role' in firm technology transfer can be developed. Again Lincoln and Guba (2000) support this proposition, stating that the criteria for judging reality or validity are not absolutist, but rather

> "...are derived from community consensus regarding what is "real," what is useful, and what has meaning (especially meaning for action and further steps)" (p. 167)

Because the study aims to identify marketing's role in firm technology transfer, it follows that reconstructing the *objective* meaning of action from the very many (inter)*subjective* communications of actors (including that of the researcher) involved in the 'cradle-to-grave' technology transfer process is an important aspect of the research methodology. Put another way, reconstruction of multiple individual and functional involvement in firm technology transfer effort - each with individual prescriptions as to what is 'important' - must ultimately reflect an objective intent to 'move' technology from the innovation stage through to final market transfer. Outhwaite (1975) describes this process as "reconstructing the objective meaning of action in the intersubjective communication of individuals in the social life-world" (p.91), and further suggests that words are not just about something but are *also about 'doing something'*.

The point here is that the study is focused on multiple individuals and groups engaged in dynamic and context specific technology transfer processes, and the constructivist-interpretive paradigm promotes objective 'explanations' of phenomena rather than merely attempting to predict it (Leavy, 1994). Moreover, because the study has a phenomenological leaning, 'everyday activities and practices come to have a sense of being observable, rational and orderly for those concerned' even when taking account of individual and unique characteristics and circumstances (Gubrium and Holstein, 2000).

3.5.1 Phenomenological leanings

Within the philosophical range of ideographic methodologies there are a number of methodologies which, while overlapping significantly, have their own distinct characteristics. In addition to phenomenology, other methodologies utilise qualitative information to understand social phenomena, and include ethnography and grounded theory (Straus and Corbin, 1990). These methodologies and their research context are compared in Table 3-2.

Research Context	Ethnography	Phenomenology	Grounded Theory
Understanding action and relationships	Focuses on social relationships and phenomena	Investigates the direct experience of subjects	Can use a variety of research approaches
Understanding subjects perceptions	Focuses on the cultural significance of phenomena	Focuses on the subject's subjective experience of phenomena	Can use a variety of research approaches

Closeness to context	Participant observation a key tool	Seeks to understand through subjects experience	Can use a variety of research approaches
Conceptual framework	Starts from theory to ground in the context	Draws on theory to identify phenomena	Seeks to discover new concepts and theory
Theoretical basis for the question	Findings grounded in the reality of the social group	Assumes some theoretical basis for the question	Rejects a priori assumptions and theory

Table 3-2: Comparison of Ideographical Methodologies
(Adapted from Crotty, 1988; Denzin and Lincoln, 2000)

Of these methodologies, phenomenology was considered to be the most appropriate to investigate the research question because, while each of these methodologies seek, or can seek, a close relationship with the subject matter, they focus on drawing different information from those relationships. Ethnography seeks to observe social and cultural information through participation (Fetterman, 1989), where phenomenology seeks to identify phenomena and events through the experience of informants (Spiegelberg, 1970), and grounded theory can use a variety of approaches.

The phenomenological approach is useful in this study because it allowed the researcher to build on the initial contemplation of phenomena by repeatedly revisiting the experience of respondents as a way to develop insight. In this way, phenomenology draws on the *richness of direct experience* to heighten perception and provide new meaning or enhance former meanings (Crotty, 1988). Phenomenology suggests that, if we lay aside, as best we can, the prevailing understandings of those phenomena and revisit our immediate experience of them, possibilities for new meanings emerge for us (Mercer and Powell, 1972). Thus, the phenomenologist attempts to see things from the actors point of view, with experience of the phenomenon coming from those who participate in the context of the research since ‘no one can experience things on behalf of the participants’ (Crotty, 1988).

Importantly, since the phenomenological method is geared toward collecting and analysing evidence in ways that do not prejudice their subjective character, procedures must put in place to minimise the imposition of the researcher’s presuppositions and constructions of the evidence. To ensure that the subjective character of experiences are not prejudiced, researchers gather evidence by way of unstructured interviews in which only open ended questions are asked. In this study, the objective here was to ensure that themes pinpointed in the evidence did, in fact, arise out of the ‘data’ and were not imposed. To prevent this, data is displayed that supports the claim that the themes they point to are genuinely to be found in the ‘data’. This attempt to understand and describe peoples subjective experience is often referred to as putting oneself in the place of the other (become the customer), or as ‘the great phenomenological principle’ (Crotty, 1988, p.83). Thus the author, in pursuit of a phenomenological methodology, strove to take a fresh look at things, or phenomena, in an effort to understand the subjective experience of research respondents.

With this focus on the actors experience of phenomena, and given the reflexive position of the researcher, the leaning toward a phenomenological perspective is therefore considered a useful strategy for the study.

3.6 The Qualitative Approach

While research studies do not actually solve problems or make decisions, they can generate information that can guide decisions and actions of management. However, within business practice, research complexity arises because practitioner problems don't sit within the neat boundaries of academic knowledge, and are frequently "messy" (Eden, Jones, and Sims, 1983). With this in mind, and in considering the complex, highly unstructured and dynamic marketing environment, it is considered that a qualitative approach is an appropriate methodology for this study because it, too, is a situated activity that locates the observer in the so called 'messy' world.

The qualitative approach can be described as a set of interpretive practices that make the world visible, turning the world into a series of representations that may include field notes, interviews, conversations, recordings, documents or memos. This means that qualitative researchers study things in their natural settings, attempting to make sense of (read: interpret) phenomena in terms of the meanings people bring to them (Denzin and Lincoln, 2000, p 3).

Qualitative research also involves the use of a variety of empirical materials, and as with this study, includes case studies, personal experience, documents, interactions, and observations, with each seeking to describe routine and problematic moments and meanings in *individuals and groups* lives. Accordingly, qualitative researchers deploy a wide range of interconnected interpretive practices, hoping always to get a better understanding of the subject matter at hand. It is understood, however, that each practice makes the world visible in a different way. Hence there is frequently commitment to using more than one interpretive practice in any study (Denzin et al., 2000; Guba and Lincoln, 1994).

The word “qualitative” implies an emphasis on the qualities of entities and on processes and meanings that are not experimentally examined or measured in terms of quantity, amount, intensity, or frequency. Qualitative researchers stress the socially constructed nature of reality, the intimate relationship between the researcher and what is being studied, and the situational constraints that shape enquiry. Such researchers emphasise the value laden nature of enquiry, seeking answers to questions that stress how social experience is created and given meaning (Denzin et al., 2000). Schwandt (1994) in Denzin et al., (2000) describes this research process as ‘giving fidelity to phenomena, respect for the life-world, and attention to the fine grained details of daily life’ (p. 193).

In contrast, *quantitative* studies emphasise the measurement and analysis of causal relationships between variables, and measuring and quantifying phenomena for the purpose of generalising findings (Flick, 1998). Proponents of such studies claim that their work is done from within a value-free framework. Without seeking to devalue the *quantitative* approach adopted by prior researchers in marketing, it is suggested that such approaches may not yield a rich understanding of the key issues affecting industrial firm marketing, instead shifting away from ‘the creativity, spontaneity and individual insight that often characterises successful marketing practices (Brown, 1993). A more appropriate methodology is required for this thesis in order to understand and explain the meanings and complexities resulting from case observations, interviews and artefacts.

To this end, Borch and Arthur (1995) recommend a methodology which will increase contextual insights and will allow for a greater understanding of forces affecting the phenomena in question, through highlighting the ‘what’, ‘how’ or ‘why’ of organisational and individual action.

3.7 Marketing Theory Development: the Qualitative versus Quantitative Debate

At this point, the question could be asked: *why adopt a qualitative approach?,* given the dominant method in the marketing and strategy academic community is 'without doubt still the deductive-hypothesis-testing approach' (Milliken, 2001). Or rather, *what are the consequences of adopting a logical-empiricist perspective* given ready acceptance of the quantitative paradigm and the notion that good marketing and strategy science should be 'objective, controlled and confirmatory' (Matthyssens and Vandenbempt, 2003).

The difficulty here is that in adopting such an approach, the tendency would be to treat behavioural concepts as physical entities, and so doing, isolate bits of behaviour from the system of which they are constituent parts (Huff and Huff, 2001). This negates any opportunity for actor involvement in the development and understanding of the 'world of marketing and technology transfer', and arguably, could limit marketing theory development. Supporting this view Mintzburg (1979), suggests that, in adopting a quantitative research approach for marketing,

> ...the researcher intent on generating a direct measure of amount of control…gets answers all right, ready for the computer; what s/he does not get is any idea of what s/he has measured…. The result is a sterile description, of organisations as categories of abstract variables instead of flesh-and-blood process. And theory building becomes impossible. , p. 585)

Other authors[15] too, stress that marketing science has a tendency to rely the quantitative approach to test complex, wide ranging theories with many interdependencies. This paradigm often forces the researcher to take a clear position regarding the multidimensionality of the concept of marketing - or indeed, technology transfer. For example, there is a widely shared perspective in the marketing literature that distinguishes between the ‘process’ dimension, ‘content’ dimension and ‘context’ dimension of strategy (De Witt, and Meyer, 1994; Mintzburg, 1979; Pettigrew, 1988). Here, the interaction between two dimensions (for instance, process and context, or content and context) is often neglected or treated superficially. Again, this is in sharp contrast to real business life where these three elements are continuously intertwined.

Reinforcing this assertion, Matthyssens et al., (2003) contend that market strategies are “always embedded in the multilevel context of industry, market, organisation, division, team and individual” (p.598) and considering these linkages will ‘enrich’ the managerial relevance of prescriptions and theories. The point here is that, while qualitative and quantitative approaches reflect different approaches to research, the qualitative approach differs in a number of

[15] See for instance Barney (2000), Ulaga (2001), Milliken (2001), O’Donnell and Cummins (1999), Hyde (2000), de Ruyter and Scholl (1998), Gummesson (2003), Shankar and Goulding (2001), Ali and Birley (1999), Gilmore and Carson (1996), and Cahill (1996) .

important ways, each of which reinforces choice of the qualitative approach for this study. Table 3-3 summarises these points of difference.

Quantitative Research	Qualitative Research
• There is reality out there to be studied, captured and understood.	• Reality can never be fully apprehended, only approximated.
• Isolates causes and effects, measures and quantifies phenomena, and generalises findings.	• Relies on multiple methods to capture as much of reality as possible.
• Conclusive, independent and dependent variables	• Impressionistic, holistic and interdependent
• Emphasis on operationalising theory	• Emphasis placed on the discovery and verification of theories
• Free of individual bias and subjectivity.	• Multi voiced texts and dialogue with subjects.
• Relies on remote inferential empirical methods and materials, focus on numbers	• Capture subjects perspective through detailed interviewing and observation, focus on words
• Abstract from the world and seldom study it directly, standing above and outside the constraints of everyday life	• See the world in action and embed their findings in it
• Unconcerned with description because such detail interrupts the process of developing generalisations	• Believe that rich descriptions of the social world are valuable.
• Use mathematical models, statistical tables and graphs, and usually write about their research in impersonal third person prose	• Use of ethnographic prose, historical narratives, first-person accounts, photographs, fictionalised "facts", biographical and autobiographical materials

Table 3-3: Important Differences Between Qualitative and Quantitative Research (Adapted from Chisnall, 2001; Denzin et al., 2000; Patton, 1990)

In summary then, this study is based on the belief that interpretive and qualitative methodologies are appropriate to cope with marketing theory development in a changing business environment, whilst also accommodating the difficulties associated with firm technology transfer. More specifically, this methodological approach allowed the researcher to gain first-hand, experiential insights into firm technology transfer effort *and* the marketing activities that influenced technology transfer outcomes. Indeed, the actual research context under scrutiny, characterised by global inter-connectedness, technology innovation, and the contextual nature of case technology effort, combined with the perceived impact on marketing's practical and theoretical role, required a research strategy that facilitated, through shared experience, rich description of the social world to make it 'visible' – warts and all. This required a strategy that could, through participation in the research setting, get close enough to the actors to allow the capture and representation of the actors 'everyday lives'.

Figure 3-1 represents an overview of the methodological strategy for this study, and depicts the author's reflexive position and the theoretical framework for addressing the research question.

World View → Relativist (multiple realities)
(Constructivist Ontology)
Epistemology → Subjectivist (co-creation of understanding)
Methodology → Ideographic
Phenomenology
(use of direct experience)
Method → Case study

Figure 3-1: Methodological Strategy for a study on Marketing's Role in Technology Transfer

While the constructivist-interpretive approach - with a phenomenological leaning - defines the thrust of the research process, the actual process of gathering qualitative data to address the research question also required a strategy, framework, and data collecting methods. This is the purpose of section two: Method.

Section Two: Research Method

3.8 Background to Method Selection

Broadly speaking, the research method outlined in this section focuses on the research question, the purpose of the study, and identifies the strategy that will be employed to answer the question. More specifically, it involves selection of a method that facilitates the phenomenological methodology chosen for the research context. Moreover, as with the selection of a qualitative methodology, the selection of a method also considers concerns expressed within the marketing literature that relate to the prevalence of quantitative research methods that typically employ questionnaires to gather highly structured data and utilise mathematical models and various statistical techniques for analysis.

As was noted in Chapter Two, numerous authors have discussed the changing business environment, the importance (and difficulty) of technology transfer and the need for cross-functional and inter-firm relationships. However, despite the widely acknowledged need for co-operative relationships, the majority of technology management and new product development (NPD) research 'fails to integrate multiple perspectives', and continues to strongly rely on single key informants to provide a complete picture of firm technology transfer effort (Biemans and Harmsen, 1995). Further, the very many studies of market orientation - and its effect on NPD performance - measure market orientation at the organisational level, but not market orientation at the NPD process level (p.517). Indeed, for Kok, (2003) firms do not really know what market-orientated NPD is and how they should implement it.

Also noted time and again in the literature was the gap that exists between what is known about a subject (theory) and what firms are doing about it (practice) (Cooper, 1998; Johne, 1995; Pfeffer and Sutton, 2000). In a benchmark study, Cooper (1998) concludes that firms consistently fail to implement well known success factors, such as incorporating the voice of the customer, doing solid up-front homework (market research) and formulating clear product definitions (value propositions). For the practitioner-as-researcher this is something of an anathema, and reflects the intent of the study to embrace a method that accommodates the contextual nature of firm technology transfer *and* the relationship between the technology transfer process and the theoretical role of marketing. And, consistent with a key objective of this study, it also reflects a methodological intent to develop practical guidelines for implementation, because "the marketing literature is rich in insights about what ought to be the content of strategies, but has few guidelines for the process of deployment" (Sashittal and Wilemon, 1996, P. 67)

3.9 The Case for the Case Study Method

As has been noted, firm technology transfer effort frequently involves cross-functional and collaborative relationships within the firm's internal market, and with external customers and suppliers. However, the literature reveals that much social scientific research continues to rely on single key informants for its data Biemans and Harmsen, 1995), despite the need for detailed information about technical, operational, market and other organisational issues. The point here is that shedding light on these issues cannot be provided by a single informant, because, for example, questions about the quality of the marketing-R&D interface will require answers to numerous questions from respondents across multiple functions. Moreover, by including 'customer' respondents the study will further ensure that the perspective of the external market network are captured and reflected in the analysis. In this way, the voice of the customer will enable the study to test the validity of the findings – particularly since the intent of the study is to develop a role for marketing in technology transfer.

Furthermore, contextual issues associated with firm technology transfer give cause for researchers to consider the scope of the sampling frame. In addition to using multiple respondents from within the firm, researchers should consider the inclusion of respondents from other firms. Arguably, what is needed is a research method that aims at gaining in-depth understanding of marketing and technology transfer by building rich, detailed pictures of technology transfer issues that account for contextual complexity and involve multiple respondents from multiple organisations, and from external customers. Indeed, practitioner experience of the highly variable nature of technology transfer practices and the equally disparate views of marketing point to the need for a multi-respondent / multi firm research design. To this end, Figure 3-2 illustrates the suitability of the case study method for this study.

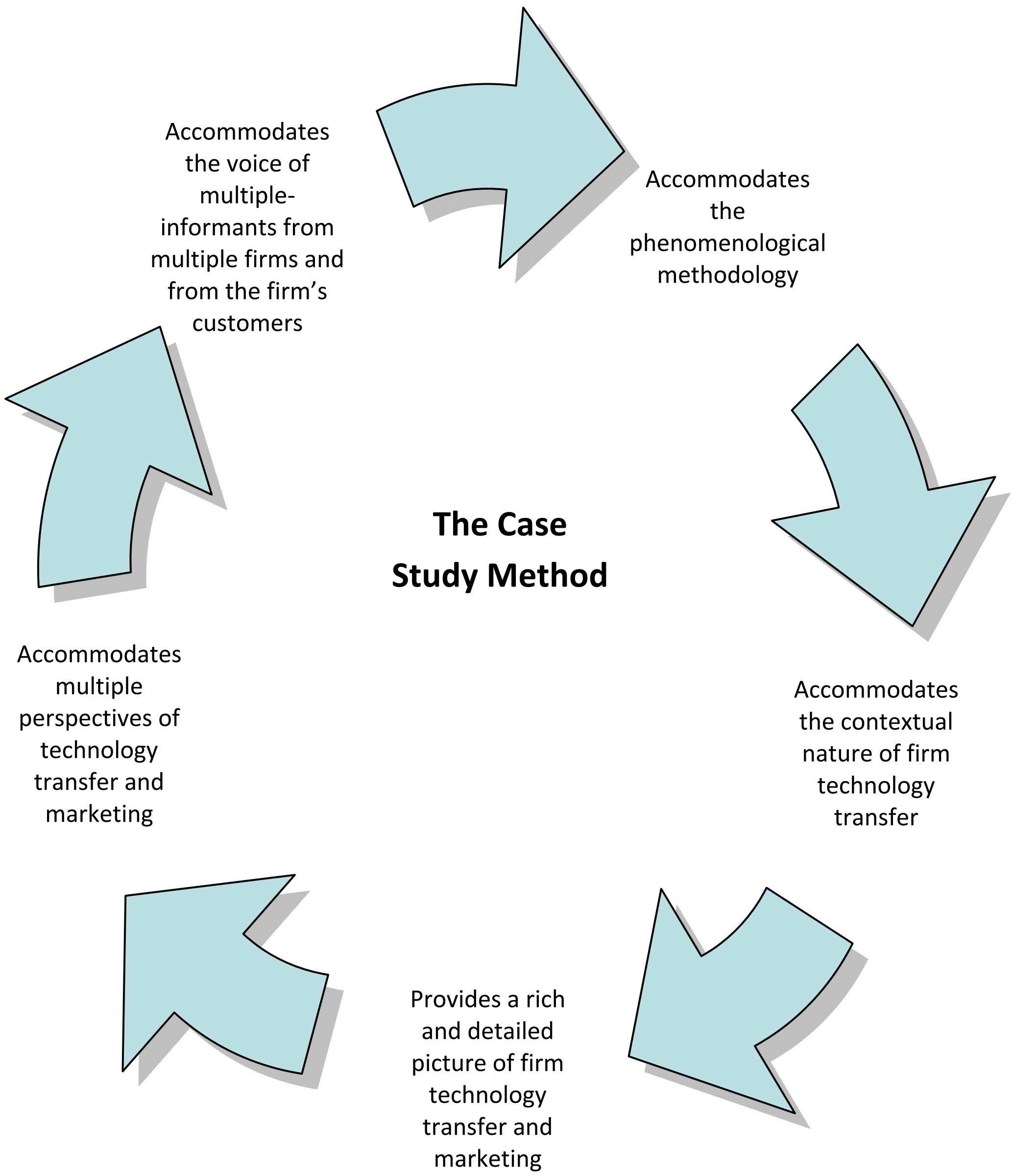


Figure 3-2: Suitability of the Case Study Method

3.10 The Case Study Method

Case study research has been defined as an empirical enquiry that investigates a contemporary phenomenon within its real life context, when the boundaries between phenomenon and context are not clearly evident, and in which multiple sources of evidence are used (Yin, 1989). Within the academic community, there exists a simplistic argument which says that case studies are 'meaningful' and 'rich' compared with the sometimes rigid empiricism of quantitative techniques. The counter argument (equally simplistic) is that case studies are lacking in rigour and reliability and that they do not address the issues of generalisability which can be so effectively tackled by quantitative methods (Yin,1994). They are also criticised for being 'unsystematic' and 'non-scientific' (Gummesson, 1991; Yin, 1994), with an alleged lack of rigor, danger of biased views, and equivocal evidence. Again, by contrast, case studies are said to shed light on the fine-grain detail of social processes in their appropriate context.

However, these types of arguments have become somewhat outmoded (Cassell and Symon, 1994). There is nothing about a method *per se* which makes it weak or strong. Rather, the argument about method 'depends on the relationship between theory and method, and how the researcher attends to the potential weakness of the method' (Cassell et al,. 1994, p.208). Indeed there appears to be a significant trend toward "appreciating the complexity of organisational phenomena, for which case study may be the appropriate research method" (Yin, 1994, p. xv)

Case study research consists of a detailed investigation, often with data collected over a period of time, in one or more organisations, or groups within organisations, with a view to providing an analysis of the *context and processes* involved in the phenomenon under study. The phenomenon is not isolated from its context (as in positivist research) but is of interest precisely because it is in relation to its context.

A case study is also described as both a research method (Gersick, 1988) and as a research strategy (Crotty, 1988). Whether method or strategy, case study is seen as a vehicle that allows sufficient depth of enquiry of the phenomena under investigation within the context of the research setting. This is very significant because, in this study, firm context is important – there is no 'right' way to transfer technology otherwise everyone would be doing it, and therefore no one data source, by itself, is likely to be sufficient to allow identification of the phenomena concerned with the research question. As Yin (1981) notes, because the context is deliberately part of the design, there will always be too many 'variables' for the number of observations made. Consequently the application of standard experimental and survey designs and criteria are not appropriate, although issues of 'validity and generalisability' have to be addressed (Eisenhardt, 1989; Yin, 1981; Yin, 1994).

3.11 Research Design

Having identified the case study as the best approach to investigating the research question it was necessary to prepare a plan for the process of data collection and interpretation. The importance of the research design cannot be overstated since its main purpose is to avoid the situation in which the evidence does not address the initial research question.

3.12 The Suitability of the Exploratory Case Study Method

The first research design process involved identifying a case study method that was suitable to answer the research question. Case studies are the preferred strategy when the researcher has little control over events and when the focus is on contemporary phenomenon within some real life context (Yin, 1994). Generally, three types of case study are identified: the explanatory, exploratory, and descriptive, with each having a different way to collect and analyse empirical evidence. Yin (1994), sets out the most important condition for differentiating among case study strategies

> “In general “what” questions may either be exploratory (in which case any of the strategies can be used) or about prevalence (in which surveys or the analysis of archival records would be favoured) “How” and “why” questions are likely to favour the use of case studies, experiments, or histories” (p.7).

Because this study will focus on questions of “what”, the exploratory approach has been selected as the appropriate case method. Indeed the exploratory approach is particularly useful because, in addition to promoting exploration of technology transfer through observation and systematic interviewing, document analysis is also part of an integrated research strategy. In this way, firm process documents and records can be compared with interview data to corroborate evidence of formalised technology transfer processes (e.g. stage-gating, market research), serving to add a richness to data collection and, inductively, data analysis.

3.12.1 Units of analysis

The second design process involves identifying the units of analysis. Because the research question seeks to understand the role(s) that marketing plays (or could play) in firm technology transfer effort, the firm is the unit that the research seeks to say something about. While this may appear to be straightforward, a key factor in the relationship to be investigated involves the experience and actions of actors involved in the process of technology transfer. Although these actors were the key source of evidence for the study, suggesting that they could be the unit of analysis, they are considered to be ‘just’ an element of the firm.

Similarly, the technology 'project' could also be considered as a useful unit of analysis, although this option was also dispelled for a number of reasons. Firstly, not all technology transfer activities are necessarily 'in a project'. That is to say that at any stage a firm capability may be matched, through market intelligence or transactional relations, to a customer or network need, and thereby transferred. This aspect of marketing and technology transfer would therefore be missed where the unit of analysis was 'the project'.

Secondly, using technology projects as units of analysis might also preclude examination of the innovation phase given that technology developments generally become projects at proof of concept or development phase i.e. post innovation. This would inhibit examination of marketing's role in firm innovation and idea generation. Similarly the potential for a role for marketing in technology diffusion might be limited using projects as a unit of analysis given that technology projects, in theory and practice, are not always concerned with ongoing customer and network relationships. Firms relate to customers – arguably projects do not relate to customers.

Thirdly, unlike evolving marketing theory, the *marketing project management literature* is 'young as a discipline' and has yet to embrace concepts of co-creation, or knowledge management, with their literature reporting that utilisation of knowledge management in project marketing is still 'largely unexplored' even though knowledge management is needed to avoid knowledge fragmentation and loss of organisational learning (Cova and Salle, 2007). Indeed it could be claimed that project marketing research is only now considered to be moving away from a process-based perspective towards one of interactions between people and projects (Leybourne, 2007).

Fourthly, firms approach technology projects in multiple ways, and project managers often assume that they are somehow in charge or are a channel captain or network commander, whereas this is by no means the case (Hakansson and Ford, 2002; Wilkinson and Grey, 2007). Using projects as units of analysis would potentially create issues of reliability and validity with respect to determining marketing's role in industrial firm technology transfer.

As the study reinforces, both theory and practice report marketing and technology transfer is increasingly concerned with organisational capabilities, knowledge, and technological resources and less to do with technology product development per se. These concepts were therefore considered to be more suited to research and analysis at the firm level.

Thus, the single unit of analysis, the firm, was incorporated in a multiple-case study design, strengthening and broadening the capacity to draw analytic generalisations from the study (Herriott and Firestone, 1983; Yin, 1989). This potential was further enhanced by selection of cases on a basis of theoretical or literal replication (Glaser and Straus, 1967; Yin, 1989) allowing the use of replication logic to anticipate propositions across cases, thereby enhancing the external validity of this study (Yin, 1989; Yin 1994).

The four firms identified in Table 3-4, which make up this study, were chosen because each identified as having a particular focus on the development and transferring of technology for market advantage. Their commonality as 'CRIs' and the charter under which they operate suggest that similar practices may occur across the CRI *Case*, a possibility that enhanced the concept of theoretical replication (Eisenhardt, 1989; Yin 1994). The firms involved in the CRI C*ase* are more fully described in Chapter Four.

CRI	Business Profile
AgResearch Limited (AgResearch)	Life science research organisation with increasing emphasis on technology product development and commercialisation. Expertise in modern biotechnologies founded on a legacy in the biological sciences of agriculture.
NZ Institute for Crop & Food Research Limited (NZ Institute for Crop & Food Research)	Creates new fruit varieties, technologies and products that add value. Its research expertise includes developments at a molecular level, making it a world-class centre for plant based biotechnology
Hort Research	Provides research and technology solutions to all levels of the Horticulture industry, including biomaterials science, alternative species, and plantation resources. Recently extended focus to meet growing consumer demand for renewable materials and technology products from plants.
Industrial Research Limited (Industrial Research)	Undertakes science and technology transfer in areas of information and electronic technologies, advanced materials and performance, intelligent devices and systems, biochemical technologies, energy technologies, and complex measurement and analysis.

Table 3-4: The CRI Case

3.13 An Integrated Method for Evidence-Gathering

A third design process involves determining the sources of evidence and data gathering techniques. Given the influence of the interpretive paradigm on this study and the selection of the exploratory case study method, several data collection possibilities were available to the researcher. Indeed, as with action research, grounded theory (Strauss and Corban, 1990; Glaser and Strauss, 1967), and ethnography (Gummesson, 1991), each tradition demonstrated an array of methods available for the qualitative researcher. The key learning here was that qualitative research requires more than one data-gathering instrument and works best when borrowing from various methods to accommodate the various situations that can arise in a research context. The conclusion for this study is that, when the contextual factors of the CRI *Case and* technology development are considered, no one research approach will be appropriate, and what was needed was a method that incorporated a range of qualitative data-gathering instruments from several qualitative methods. This does not imply incommensurability of research paradigms, but simply meant that an 'integrated' approach within an interpretive ontology was adopted.

As illustrated in Figure 3-3, the integrated method borrowed from various research traditions. The early stages of the research predominate in the use of methods more readily associated with ethnography and grounded theory. These include participant observation, unstructured interviews, examination of company documentation, technology and market 'audits' and in-depth discussions. Later data gathering phases concentrate quite heavily on semi structured in-depth interviews.

This combination of multiple methodological practices, empirical materials, perspectives, observations, and the voice of the customer in a single study is best understood, then, as a strategy to add rigor, breadth, complexity, richness, and depth to the study (Flick, 1998, p. 231). The use of multiple sources of evidence also facilitated triangulation of the data, serving to enhance the construct validity of the findings in this thesis (Eisenhardt, 1989; Yin 1994).

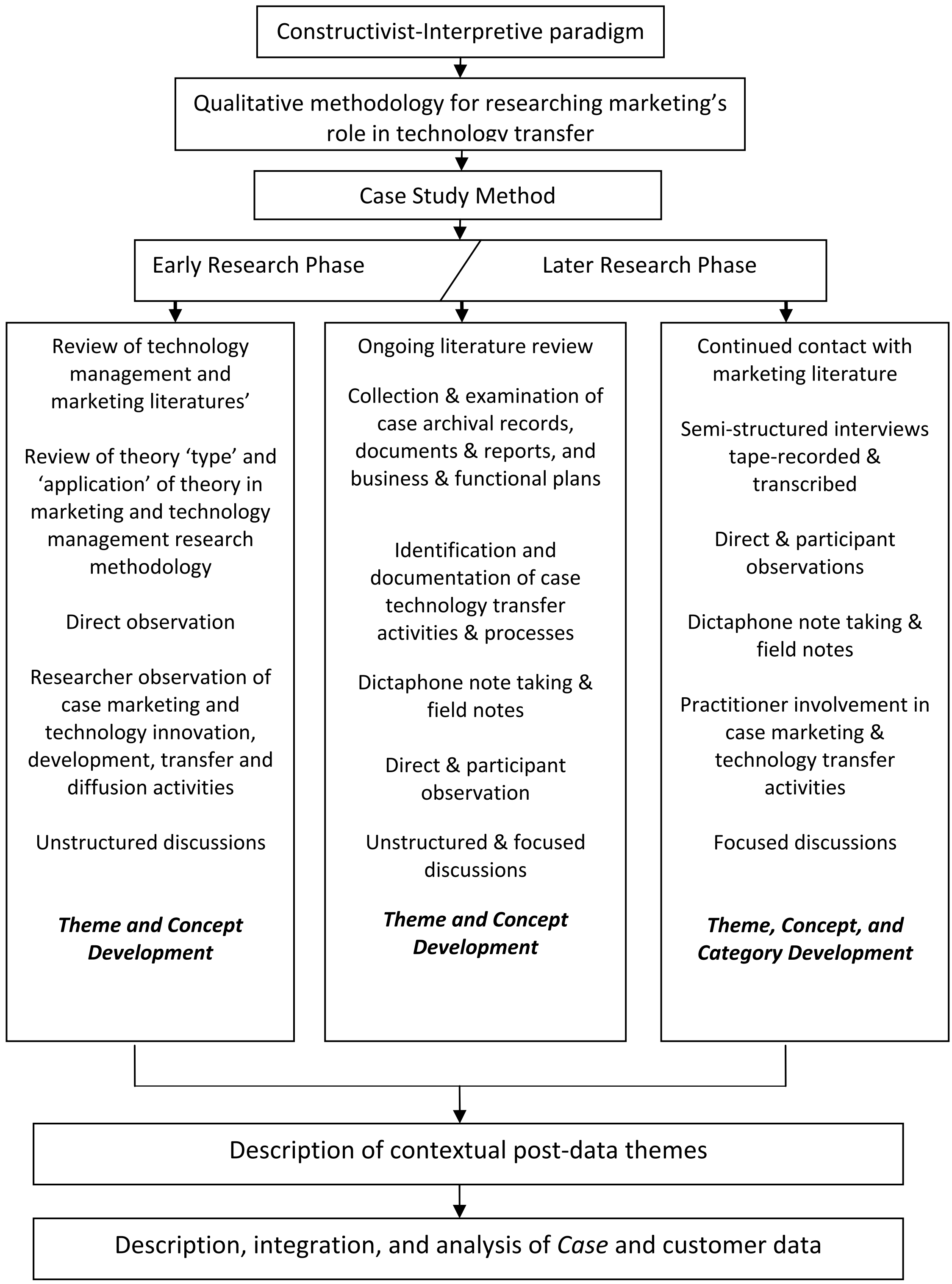


Figure 3-3: An Integrated Method for Researching Marketing's Role in Technology Transfer

In order to illuminate actual technology transfer activities in the CRI *Case*, the researcher considered it vital that the objectives of the study were both transparent to, and engaged by, participating science and marketing/commercial staff. The research strategy thus sought to eliminate any perception that the project was an 'audit', but rather was an opportunity to explore ways in which marketing and its relationship to technology transfer can be understood within the context of each firm, and from the subjective perspective of the key informants. In short, trust, candour and openness were vital ingredients to the study's success. Perceptibly, the degree of enthusiasm to participate by science and commercial staff was significant in this process.

Semi-structured interviews were conducted with key informants from multiple functional areas across and within the CRI case. These informants included members of technical and R&D teams, and marketing personnel from business development or commercialisation teams. Additionally, interviews were conducted with customers of the CRI Case so that the voice of the customer was reflected in the raw data. The interviews, while open ended, focus on the framework of interview questions defined in the case study protocol. Interview transcripts were tape-recorded for later transcription and supported by reference to researcher written and dictated notes immediately after each interview. This process allowed the researcher to keep focused on the interview questions, with post-interview review facilitating early development of themes, concepts, and patterns as part of the qualitative research process (Yin 1994). It also allowed informants to provide their own, subjective, version of their experience of firm technology transfer.

While the interviews provided an important part of evidence collection, the risk of informant bias and reflexivity needed to be considered (Remenyi, Williams, Money, and Swartz, 1998), and the verbal transcripts and interview reports needed to be corroborated using other sources of evidence (Yin 1994). Indeed particular care was needed to ensure that the interviewee accounts, as far as possible, refered to something external to the interview situation, rather than reflecting the interview situation as a complex social setting. All interview material therefore, called for careful critical reflection by the researcher, with interpretations going ‘beyond script-following accounts and impression management’ (Alvesson and Deetz, 2000).

Because the researcher had previous contact with the CRI case, some observations relating to the formulation of the research question was therefore possible prior to the commencement of the study. On initiation of the study, case evidence was gathered through unstructured discussions, and participant observation before and after the key informant interviews. In this way, observations were specific to the research question and the research context (Maxwell, 1998), focussing on technology transfer activities, processes and behaviours. These observational aspects are more fully explained in the case study protocol. Additionally, further evidence was gathered through direct (but non-participative) observation, and while this did not include observation of the actor's perceptions and actions, it is however, specific to the research question and context. Importantly, these types of observations are free from informant bias or reflexivity and enhance the triangulation process and the validity of the findings (Remenyi et al., 1998).

Collection and examination of case documents and related artefacts are also an integral element of qualitative research (Bryman, 1992; Sarantakos, 1993). Polkinghorne (1983) emphasises this when he states: "The most exact and accessible form of expression is written linguistic expression.....collected by the researcher in the form of personal or public documents" (p.265). The case study research strategy adopted for this study also facilitated the use of document analysis as a method of data collection and analysis (Denzin et al., 2000). Therefore, numerous firm documents were analysed in an attempt to illuminate and understand the participants lived experience. This approach also allowed for thematic development of patterns and trends in *Case* technology transfer effort.

The method employed for document analysis began with identification of the relevant documents. In this study, all case documents that related to formal and informal technology transfer processes together with business and marketing plans were of express interest to the researcher on the basis that they indicated the level of sophistication and adoption of technology transfer activities and processes in the *Case*, as well as indicating the type and degree of marketing involvement in this effort. Additionally, historical biographies and firm annual reports were scrutinised as a way to confirm and corroborate the other forms of evidence and strengthened the credibility of the interview results. As with direct observations, these evidential documents are free from the reflective bias of the researcher.

Section Three: Case Study Protocol

3.14 Background

Section Three is the specification for the execution of the study's multiple-case design. It provided direction and a qualitatively induced framework for use by the researcher during the gathering of evidence, data analysis and case study reporting (Yin, 1994). The procedures and boundaries defined in this protocol draw on established qualitative research practices to set strategies that are framed in terms of a conceptual framework for the technology transfer process (Figure 2-9). This ensured that the study stayed focussed on the research question: what is marketing's role in technology transfer? The case study protocol is thus a major tactic for increasing the reliability of case study research and was intended as a guide to conducting the case study (Creswell, 1994).

In providing a specification for this study, the research objectives and research strategy are defined in section 3.2 and 3.3 respectively. Preparations required prior to evidence collection, including case identification, visitation, and ethical considerations are discussed in section 3.4; and procedures for evidence collection, the interview instrument and question prompts are explained in section 3.5. Analysis strategy and methods are defined in section 3.6 while the format for case study reporting is outlined in section 3.7.

3.15 Research Objectives

Restated, the objective of the study is to explore and interpret marketing's role in firm technology transfer. The primary goal is exploration, illumination and description of marketing's theoretical role (processes and activities) in firm technology transfer effort, from idea inception and technical innovation, through to customer adoption and diffusion.

The study addresses the question: What are the roles that marketing plays in industrial firm technology transfer effort?

The key issues on which this study will focus are contained in the conceptual framework of the technology transfer process, Figure 3-4, which underpins the research question.

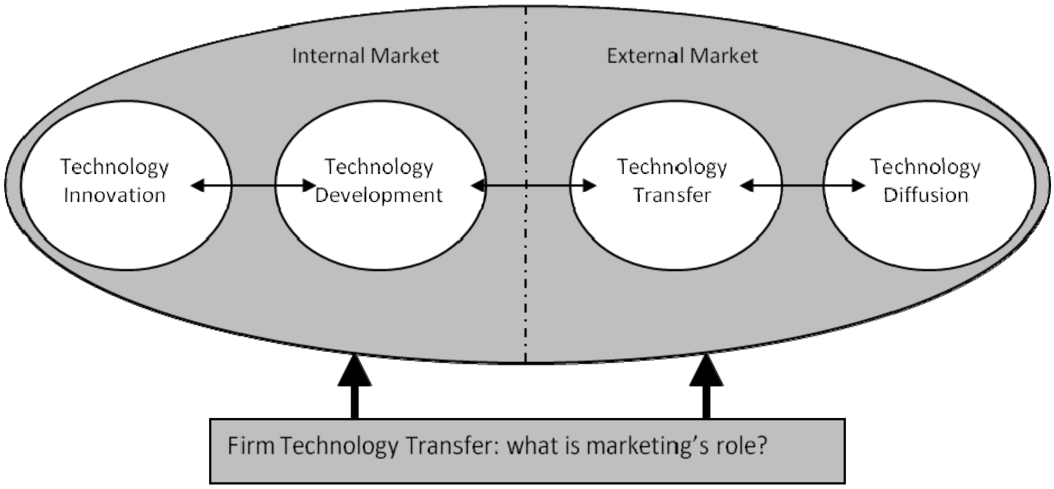


Figure 3-4: Firm Technology Transfer: what is marketing's role?

The conceptual framework identifies four constructs that will be the focus of evidence gathering: technology innovation, technology development, technology transfer, and technology diffusion. Additionally, evidence related to the firm's internal market and the firm's external market, and their role in terms of the research question are also identified and understood.

3.16 Research Strategy and Methods

The strategy used for the study is a multiple-case design (Yin, 1994). Drawing on a methodology of phenomenology, evidence gathering within cases focuses on the experience of the actors to explain phenomena and relationship with the research question.

The context for the application of the research strategy involves CRIs who are engaged in the innovation, development, and transfer of technology products and services. Within this context, the units of analysis are the firm's, with each firm being a separate *Case* within the multiple design.

The principle instruments of evidence collection are semi-structured interviews, augmented by participant observation, focused and unstructured discussions, and firm records and reports. Data from the evidence is managed and processed using established qualitative techniques, and involve the development of themes, concepts, and patterns, to assist in the explanations sought in the research question.

The study adopted a pragmatic approach to the research strategy, albeit that actual operation is non-linear. Once the research question was determined, the study design follows a series of qualitative steps to execute the strategy, illustrated in Figure 3-5:

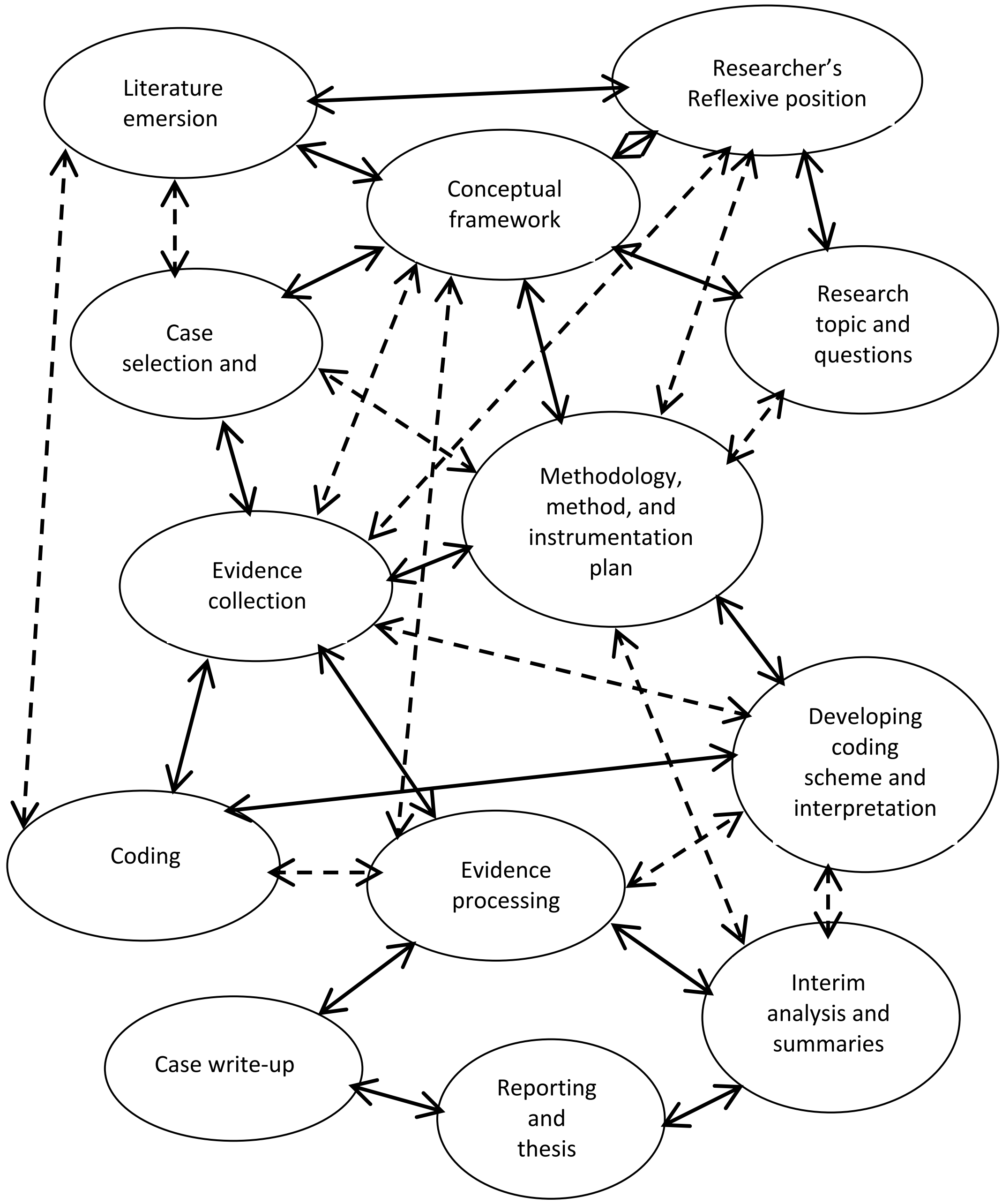


Figure 3-5: Qualitative Considerations in the Research Strategy

3.17 Preparation for Evidence Collection

Previous employment history and a developed relationship with the Foundation for Research Science and Technology (FRST) meant that the researcher had experience of the New Zealand science and innovation 'system', and to an extent, had an awareness of CRI research and development activity.

These CRIs are the focus of this study (the case), and after consultation with FRST and researcher examination of CRI annual reports, four NZ CRIs were selected and approached on the basis that they actively pursued the development of technology and technology products for commercial market advantage. In this way, each CRI was considered a "purposive" sample of industrial firms engaged in the process of technology transfer (Silverman, 2000) leading to researcher expectation of "replication logic" (Yin, 1994, p. 45.)

The strategy to engage the four CRIs consisted of:

1 Gaining a mandate to proceed with the case study research from each of the five CEO's.

2 Gaining permission to access to relevant company documentation concerning marketing and technology transfer strategies, plans, and processes

3 The determination of a key contact - usually the senior scientist or commercial person - and identification of key functional personnel for interviewing

4 Distribution of the ‘participant information sheet’ to key informants

5 Conducting the semi-structured interviews and interview follow-up

3.17.1 Visitation

Critical to the study was gaining a mandate to proceed with the research from each of the five CEO’s. The strategy was to meet with each CEO during office working hours to describe the objectives and strategy for the study. It was expected that this meeting would also facilitate an introduction to key contacts within the organisation for the research exercise. Once the relationship with the key contact was established, a follow up meeting was arranged with the express purpose of identifying and arranging copies of key documents, and the identification and contact details for suitable interviewees. It was up to the researcher to make contact with each informant.

An important issue raised in the initial contact with the interviewee was the need to tape interviews. While there was some slight reluctance from some informants due to perceived sensitivities associated with ‘dobbing’ in the firm, its processes, or other members of the firm, tape recording ensured that the whole interview was available for the analysis process (Merriam, 1988). Tape recording also freed the interviewer from intensive note taking and facilitated attentiveness to the informant and the progress of the interview (Patton, 1990).

On contact with the informant, the protocol dictated that:

- Contact details will be swapped between the researcher and informant
- A suitable time during the working day for the interview will be arranged, with the provision for a back up time
- The respondent will be asked to allow for up to two hours for the initial interview
- A suitable venue will be arranged with the proviso that it is a private setting, and, ideally, free from interruption.
- The respondent will be asked to make provision for a follow up discussion at a later date, to allow for additional questions, or to clarify aspects from the initial interview
- The respondent will be made aware that his/her confidentiality will be protected, and that a pseudonym will be used in the case write-up

3.17.2 Ethical considerations

A key feature of the qualitative research interview method is the nature of the relationship between the interviewer and interviewee. The relationship is part of the research process and not a distraction from it. In qualitative research, the interviewee is seen as a participant in the research project, actively shaping the course of the interview rather than passively responding to the interviewer's questions (King, 1994). Within this process, and in the resultant analysis and reporting, research practices must reconcile the demands of the researcher's scientific enquiry with the right of the informants to privacy and free choice (Cook, 1986). The use of good ethical practices underlies the neutrality that social research seeks to achieve and supports the validity and reliability of the research findings (Christians, 2000).

In order to safeguard the rights of the case firms and the informants participating in the study, value free principles were employed in the interviews. These principles included:

- Ensuring interviewees participate on the basis of informed consent
- There will be no deception of informants at any stage in the research process
- The privacy and confidentiality of firms and individual informants will be safeguarded during the research process

As a framework for these standards, the University of Waikato "Handbook on Ethical Conduct in Research" was used as an ethical benchmark. The researcher was responsible for ensuring that this study complied with the University's Human Research Ethics Regulations. In conforming to these regulations, the researcher gained ethics approval before the fieldwork commenced, and obtained informed consent from the interviewees prior to conducting the interviews.

3.18 Procedures for Evidence Collection

An important part of evidence collection is the preparedness of the researcher, both in terms of physical resources and knowledge. Ensuring that the necessary physical resources were at hand, and foreknowledge about the case and the respondents, helps the interview go smoothly and good rapport is developed between the researcher and the respondent (Sanger, 1996). Indeed the quality of this initial introduction set the tone and standard for the whole interview process (Guba et al., 1995).

Although the primary sources of evidence for this study are participant interviews, observations, and document analysis, in fact five generic sources of evidence were utilised. These five forms of evidence are presented in Table 3-5.

Source of Evidence	Strengths	Weaknesses
Interviews with technical and commercial staff	• Targeted, -focuses directly on case-study topic • Insightful – provides perceived causal relationships	• Bias due to poorly constructed questions • Response bias • Inaccuracies due to poor recall • Reflexivity – interviewee gives what interviewer wants to hear
Direct	• Reality – covers events in	• Time-consuming

Observations	real time • Contextual – covers context of event	• Selectivity – unless broad coverage • Reflexivity – event may proceed differently because it is being observed
Participant Observations	• As above • Insightful into interpersonal behaviour and motives	• As above • Bias due to investigator's manipulation of events
Firm Documentation and Archival Records	• Stable – can be referred to repeatedly • Unobtrusive – not created as a result of the case study • Exact – contains exact names, references, and details • Broad coverage	• Retrievability – can be low • Biased selectivity, if collection is incomplete • Reporting bias – reflects (unknown) bias of author • Access – may be deliberately blocked
Firm Process Artefacts	• Insightful into firm processes • Covers context of event • Insightful into technical and marketing operations	• Retrievability – can be low • Biased selectivity, if collection is incomplete
Customer Interviews	• Includes the perspective of the customer	• Response bias

Table 3-5: Sources of Evidence
(Adapted from Yin, 1994)

3.18.1 Interview practice

In this study, the goal of the interview "is to see the research topic from the perspective of the interviewee and to understand how and why he or she comes to have this particular perspective" (King, 1994, p. 14). Interviewing can take a variety of forms, with the literature referring to a continuum, with 'structured interviews at one end, and in-depth interviewing at the other' (Yin, 1994). In structured interviews, standardized questions are carefully ordered and worded in a detailed interview schedule, with each subject asked exactly the same questions in exactly the same order. While these questions are inflexible, they enable the researcher to code the responses more easily, although they do not allow the researcher to determine from the informant what is relevant *to them* or allow *them* to express different views. This shortcoming leads many researchers to consider alternative interviewing strategies such as unstructured or focused interviews where the interviewer does not enter into the interview setting with a planned sequence of questions for the respondent. The objective for the unstructured interview is to cause some preliminary issues to surface so that the researcher can decide what variables need further in-depth investigation (King, 1994). Unstructured interviewing can provide a greater breadth of data than other types, given its qualitative nature (Fontana and Frey, 2000). Unstructured interviews are also said to go ‘hand in hand’ with participant observation (Lofland, 1971), and much of the evidence gathered in participant observation can come from informal interviewing in the field (p. 652).

Open-ended questions are also used in structured interviews - a technique often referred to us semi-structured interviews. These are questions in which the researcher asks the informant how they feel about the topic under scrutiny, with answers often leading to further questions, which some authors argue increase data coding difficulties (Yin, 1994).

In this study, focused or semi-structured interviews were favoured because they are used as part of the more qualitatively orientated in-depth interview model, allowing the researcher to use the broad topic in which they are interested to guide the interview. This interview method according to Kidder and Judd (1986), utilizes ‘repeated face-to-face encounters between the researcher and informants directed towards understanding informants perspectives of their lives, experiences or situations as expressed in their own words’ (p.77). As the interview proceeded, the researcher rephrased and reflected back on what the informant was saying in order to check and confirm their understanding of the preceding dialogue (Whyte, 1982). Importantly, the semi-structured interviewer also ‘needs to be reminded of certain areas which need to be discussed in the interview sessions’ (Taylor and Bogdan, 1984). For Taylor et al., this usually consists of a list of general questions and issues that the researcher wants to cover and is used to jog the memory of the interviewer about certain issues or themes (p.82).

Importantly, the quality of interviews in case study research is a key influence in the quality of the later analysis and the validity and reliability of the study (Kvale, 1996, Yin, 1994).

3.18.2 Interview question guide

The key tool used for providing structure and focus for the interviews was the interview guide. The questions indicated in the guide acted as prompts for the researcher as the interview progressed (Yin,1994). The interview guide was not, however, an inflexible tool, and the questions posed changed as the study proceeded, informed by preceding interviews and feedback from the analysis process. The interview guide format is illustrated in Table 3-6.

Thematic Constructs	Thematic Question Prompts	Dynamic Question Prompts
Technology Transfer	Technology Innovation	What activities & processes support innovation?
	Technology Development	What activities & processes support technology development?
	Technology Transfer	What activities & processes support technology transfer?
	Technology Diffusion	What activities & processes support technology diffusion?
	Knowledge Development	What activities & processes support technical knowledge identification and development
	Knowledge Transfer	What activities & processes support technical knowledge dissemination and transfer?
Marketing Management	Internal Market	What internal market activities & processes support technology innovation, development, transfer and diffusion?
	External Market	What external market activities & processes support technology innovation, development, transfer and diffusion?

	Knowledge Development	What activities & processes support identification and gathering of market intelligence
	Knowledge Transfer	What activities & processes support dissemination & transfer of market intelligence?
	Internal Relationships	What activities & processes support internal market relationship development?
	External Relationships	What activities & processes support external market relationship development?

Table 3-6: Case Interview Guide

Prompts are shown in the interview guide as either ‘thematic’ or ‘dynamic’ (Yin, 1994). Thematic prompts are seen as relating to the substance of the thematic constructs that provide the basis of the study’s theoretical framework, developed from the literature review and the researcher’s reflexive position. Thus structuring the interview guide around these constructs ensured continued focus on the research question, and importantly, allowed for comparison of the developed literature themes with transcribed interviews (e.g. ‘relationships’, ‘knowledge’). In this way, the qualitative researcher can provide what Alvesson et al., (2000) describe as ‘consistent interpretations’. Comparing and contrasting themes is thus seen as an *important part of actual evidence collection* and eventual *triangulation*. So too, are the dynamic prompts seen as generating evidence about the experiences of informants as they relate to the interview themes.

Before detailed classification and coding started, transcripts of the interviews were referred back to the informants for their comments, confirming the accuracy of the transcripts and facilitating (ongoing) relationship and further evidence collection. Once the researcher had a feel for the evidence, more detailed coding and thematic development commenced.

3.19 Analysis Strategy and Method

The analytic strategy for this study relies on the theoretical propositions that led to the case study. The original objectives and design of the case study were based on the proposition that the practice and theory of marketing was, to an extent, out of step with the new economy business environment, and in particular, did not reflect significant involvement with technology transfer despite theoretical acknowledgement of the importance of technology innovation and transfer for firm market advantage. Further, new 'concepts' were emerging in marketing theory development (e.g. technological knowledge, inter-firm technical co-operation and relationships), providing new insights for the marketing practitioner. These theoretical propositions thus shaped the plan for evidence collection and analysis, and helped focus attention on certain data themes and to ignore other data (Yin, 1994).

For qualitative researchers, the heart of data analysis is the task of discovering themes forming patterns, looking at contrasts, clarifying relationships, and building a coherent understanding (Miles and Huberman, 1994), and within each of these approaches, specific methods can be employed, for example comparative analysis, causal chains, and matrix displays. Theme identification goes to the core of qualitative research, but seemingly, it is also one of the most mysterious. Explicit descriptions of theme discovery are rarely described in articles and reports, and if so, are often regulated to appendices and footnotes.

Themes are often described as abstract (and often fuzzy) constructs that researchers identify before, during and after data collection (Denzin et al., 2000), and because there is more than one way to induce themes, they are developed from a number of sources. For example, sources can range from literature reviews, professional definitions, commonsense constructs, the researchers prior experience, interviews, line by line reading of text, observations, processes, actions, assumptions and consequences, or from repetitions of words and shifts in content (p.780). Spradley (1979) and Kvale (1996) suggest looking for things that people do in managing impersonal social relationships and information about how people solve problems. Miles et al., (1994) suggest that researchers start with some general themes derived from reading the literature and add more themes and sub-themes as they go. Alvesson et al., (2000) suggest that

> "An important methodological rule.....is to develop access to and *use several vocabularies and theoretical perspectives* which, in a systematic way, may facilitate insights" (p. 116, *italics* the writer's).

The important point here, is that 'themes' can come from many sources and that no matter how the researcher actually does inductive coding, 'by the time s/he has identified the themes and refined them to a point they can be applied, a lot of interpretive analysis has been done' (Denzin et al., 2000, p.281). The ultimate aim of this study therefore, was to identify themes that explored and described case technology transfer, and the role(s) that marketing played in this process.

The phenomenological methodology, which underpinned the raw data in this study, implies the use of phenomenological research methods, suggesting that the research stops at the moment of generalisation and makes little attempt to connect sets of constructs or covering laws (Miles et al., 1994). However this approach to analysis might unduly restrict the potential breadth of the data gathered, and reduce the study's potential for construct *and* external validity.
In order to mitigate this risk, the phenomenological method of 'hermeneutics'[16] was used in the interpretation of 'texts from the field' (Denzin et al., 2000) (i.e.

[16] The application of 'hermeneutics' relates to problems that arise in the process of interpretation when one element, for instance in a text, can only be understood in terms of the meaning of

individual versus firm representations of marketing), focussing more on interpretation than on gaining empirical knowledge of social or natural facts (Miles et al., 1994). Nonetheless, the study aims to construct a coherent, internally consistent argument – one with theoretical referents from a series of "empirical facts" in the form of texts, documents, perceptions and social acts. To this end, the researcher followed a process of multiple readings, observations, and condensations of the evidence in the search for regularities and essences, with this empathy and familiarity supported by further dialogue with informants, and with the theoretical framework and constructs developed from the literature.

3.19.1 Thematic analysis

Before commencing detailed and systematic analysis, a loose 'play with the data' (Yin, 1994) augmented some of the themes from the literature review, providing some preliminary ideas about what to analyse and what not to analyse. This 'playing with the data' included reading the interview transcriptions with reference to field notes and firm documentation compiled after site visits. In this way the data, when viewed with the literature themes, will "kick start the analysis" (Silverman, 2000).

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others or of the whole text, yet understanding these other elements, or the whole text, in turn presupposes understanding of the original element.

Within this process, two categories of related themes and sub-themes were used, reflecting the major strands of the research and thinking during the early research phase (refer Table 3-7, below). As the study progressed, more finely developed criteria for inclusion or exclusion into the sub-themes assisted with data reduction. The two categories are separated on the epistemological basis of *"a priori"* (knowable independently of experience), and *"a posteriori"* (knowable on the basis of experience).

Category One Themes - *a priori*			
Theme	**Source**	**Rationale**	**Data Management**
Technology Management	Extant technology management literature	Indicator of theoretical management practices & issues concerning technology innovation, development, transfer & diffusion	Collation, description, exemplars, themes, concepts, & patterns
Industrial Marketing Management	Extant internal and external marketing management literature	Indicator of theoretical marketing management practices & issues concerning technology innovation, development (internal), transfer & diffusion (external)	Collation, description, exemplars, themes, concepts, & patterns
Category Two Themes - *Empirical / a posteriori*			
Sub-Themes	**Source**	**Rationale**	**Data Analysis**
Contextual innovation and technology transfer activities and processes	Literature, field notes, firm documentation, direct & participant observation, semi-structured interviews,	Indicators of case technology innovation, development, & transfer effort	Collation, description, data reduction, themes, concepts, & patterns

	reflexivity of researcher		
Contextual internal and external marketing activities and processes (roles)	Literature, field notes, firm documentation, direct & participant observation, semi-structured interviews, reflexivity of researcher	Indicators of case internal & external technology marketing effort (roles)	Collation, description, data reduction, themes, concepts, & patterns
Contextual technological knowledge management activities and processes	Literature, field notes, firm documentation, direct & participant observation, semi-structured interviews, reflexivity of researcher	Indicators of case technological knowledge management effort	Collation, description, data reduction, themes, concepts, & patterns
Contextual relationship management activities and processes	Literature, field notes, firm documentation, direct & participant observation, semi-structured interviews, reflexivity of researcher	Indicators of case relationship management effort	Collation, description, data reduction, themes, concepts, & patterns

Table 3-7: Sources of Themes

3.19.2 Open, axial, and pattern coding

A number of methods were employed to develop codes and themes from the evidence. In addition to comparing and contrasting interview data with case documentation, and reflexive observations, interview text was reduced to ‘words’ and ‘blocks’ of text. This promoted analysis and interpretation of key words and concepts, and facilitated use of 'word counts' and 'matrix analysis' techniques to confirm occurrence of themes, concepts, and patterns (Denzin et al., 2000; Miles et al., 1994).

Coding and thematic development from the interview transcriptions followed the precepts of Grounded Theory (Straus et al., 1990), and used techniques of open coding, which selects key words and sentences from coded text; and axial coding, which requires the researcher to define, develop and inter-relate the categories that were coded for each document. Additionally, the technique of pattern matching was employed to categorize themes and patterns with concepts in theory and practice. In this way, further themes and patterns emerged (validating earlier codes and themes), and assisted in the development of explanations and conclusions sought in addressing the research question (Miles et al, 1994).

For case studies analysis, the logic of pattern matching is a particularly desirable mode of analysis (Yin, 1994), enabling the search for evidence of fit between the constructs contained in the conceptual framework (Figure 2-9) and thematic phenomenon from the research setting. In this mode of analysis, empirical patterns will be compared with theory in order to test for literal replication, and, additionally, rival patterns of interest will be postulated and tested for explanation. It was hoped that this identification of pattern matches, when compared with emergent marketing theory, strengthened the case for analytical generalisation *and* reliability of the study (Miles et al., 1994; Yin, 1994), and is consistent with the study's integrated methodology.

These activities of data reduction and display lead to increasingly focused description, classification and connection to phenomena identified in the experience of the informants (Dey, 1993). However, while these modes of analysis were geared toward data reduction, data was also analysed and examined using pattern coding techniques so that the data themes could be matched with patterns in theory and from practice. In this way, further themes and patterns emerged (validating earlier codes and themes), and assisted in the explanations and conclusions sought in the research question.

3.20 Case Study Report

It is acknowledged that the reader brings their 'own' conceptual structures to the reading of this text, and that, however clever or elaborate the researcher's writings, case researchers, like others, pass along to the reader some of their personal meanings of events and relationships.

Conceptually, for the reader, this *Case* is a combination of cases already known (Denzin et al, 2000). "A new case without commonality cannot be understood.

Yet a new case without distinction will not be noticed” (p.442). With this in mind, the author, as a phenomenological researcher attempted to present and describe the case in sufficient detail so that the reader is shown how the phenomenon exists within the case, with illustration of exemplars providing ‘valuable and trustworthy knowledge’ (Vaughan, in press).

The reporting of this study underwrites and forms part of a thesis to be presented in partial fulfilment of the degree of Doctor of Philosophy. As part of this thesis the reporting of this case study is a key section on which the thesis as a whole will be judged. The writing of the case report and the analysis follows guidelines from Yin (1994) who suggests some useful criteria for developing case presentations:

Aspect:	**Suggestion:**
Structure	• The chapters, sections, subtopics and other components must be organised in some way • The report should be ‘engaging’
Bulkiness of case-reports	• Innovation in presentation should deal with a major disadvantage of the case study – its length
Descriptive data	• Include a section that contains descriptive data about the case being studied, including qualitative and quantitative data
Reporting multi-case data	• The multiple-case report should contain multiple narratives as separate chapters or sections, and include a section covering cross case analysis and results
Completeness	• The distinction between the phenomena being studied and its context is given explicit attention;

	and that the case demonstrates that the investigators effort was spent collecting the relevant evidence • The evidence for the study must be contained within the case study data • The reader must get a sense that the researcher 'knows their subject'
Alternate perspectives	• Examination of the evidence from different perspectives, especially the major actors, will increase the chances that the case study will be exemplary. This should include perspective that challenge the design of the study
Theory building	• The sequence of chapters and sections can follow some theory building logic, with each chapter or section reinforcing the theoretical argument being made • Exploratory cases will be debating the value of further investigating various hypotheses or propositions

Table 3-8: Criteria for the Multi-case write up
(Adapted from Yin, 1994)

The composition of the report follows a linear-analytic structure, with the sequence and the subtopics driven by the research question and the theoretical conceptualisation of technology transfer (Figure 2-9). In this way, the evidence and the findings is presented in terms of the constructs identified in the conceptual framework, or as revealed by the study. The report also indicates the boundaries within which evidence has been gathered, identifies rival propositions, and displays the evidence on which the findings are grounded.

As indicated in the ethics section of this protocol, the anonymity of cases and informant will be protected in the case study report. Although this practice protects the confidentiality of the case and the participants, it may be seen as compromising the study by removing the cases from the research setting and increase the complexity of the analysis (Yin, 1994). In order to mitigate the risk of losing contact with the context of the study, the researcher continued to be a participant observer during the write-up of the case, and reviewed the study findings against the content of the original interview transcripts. It was hoped that this would improve the accuracy of the report and enhance the validity of the study.

Chapter 4 - THE CRI CASE

'Is marketing a specialist function with general applicability or a general function that is specifically applied'? (Bartels, 1974)

Introduction

The purpose of Chapter Four is threefold. Firstly, it backgrounds the Crown Research Institute (CRI) *Case* through exploration of the political drivers that underpin a shift in emphasis from science 'inputs' to technology transfer 'outcomes'. The intent was to provide a 'rich and systematic account of the history of the business relations and networks' from within the CRI *Case* (Gardner, 2000). Secondly, it places in context the technology transfer and marketing data collected from each *case* firm as a precursor to the analysis and interpretation developed in Chapters Five and Six.

The chapter is broken into two sections. To set the scene, the first section presents a history of the CRI *Case*, and provides a background to its formation and raison d'être within the context of the 'New Zealand science system'. Here, the Government's intent to facilitate a national scale R&D capability is explored, with particular attention paid to documentary themes suggesting that technology transfer 'outcomes' can be achieved through collaborative relationships and the development of technological knowledge. Documentary themes that suggest impediments to CRI technology transfer are also explored.

The second section introduces the firms within the CRI case that are the units of analysis for the study. This is the research setting, and the intent here is to describe the technology transfer effort of each case firm and begin focusing on the primary goal of the study: exploration of the various roles that marketing plays, or could play, in industrial firm technology transfer effort.

Section One: Background to the CRI Case

4.1 The Birth of the Crown Research Institute

During the 1980s and 1990s the focus of successive New Zealand Governments was on making the public service more cost-effective and on driving economic reform. This came to be known as the “state sector reform process”, and was a response to New Zealand’s declining economic performance and the perceived lack of accountability in the public service. Wide ranging economic and social reforms were undertaken and the publically funded ‘science system’ was not immune to these changes. Indeed, it was believed that in order to deliver effective science outcomes for the New Zealand economy into the 21st century, radical changes were needed in both the funding and structural foundations of this sector.

Up until the 1980s, New Zealand's 'science system' was represented by the 'Department of Scientific and Industrial Research' (DSIR), and the research arms of the Ministry of Agriculture and Fisheries, and the Ministry of Forestry. For more than half a century these science organisations employed 'scientists to do science'[17], and had remained relatively autonomous from periodic changes in the political landscape. However in 1984, driven by a weak economy, a newly elected Labour government suddenly wanted science to pay its way – at least more so than it had done in the past.

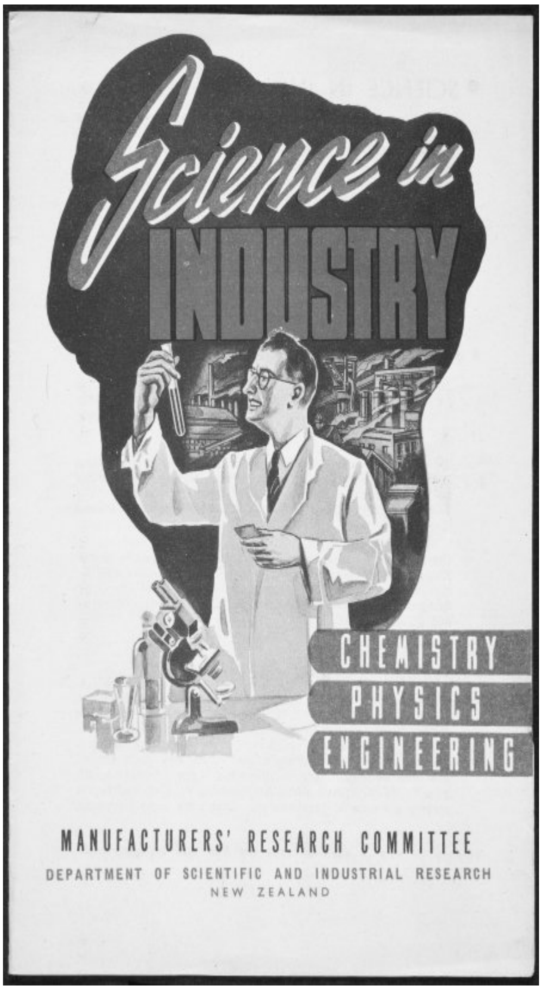

Figure 4-1: DSIR Science, circa 1950

This heralded major changes for the Ne science system. Up until this time New Zealand's science organisations had received an annual grant to be used for science that was considered 'for the nation's best interests' – with no questions asked – and fierce debate began to

[17] Up until the mid 1980s, fundamental or basic science was considered of 'greater good' than doing applied science.

play out between scientists and economists as to the appropriate structure for the nation's science investment[18].

On one hand government economists were looking to determine 'appropriate' mechanisms for science funding, and were concerned that R&D expenditure should be justified on the basis of contestable bidding, rates of return, and net present value. On the other, scientists were arguing that 'user pays' threatened the very nature of what it was to provide New Zealand with 'public good' from science. This was exactly the opposite of how the economists saw it, and they remained determined to force through a competitive economic model, and having the ear of the politicians, they held the power.

As the debate intensified, a committee was established in 1984 to review the sector, duly reporting their findings in a document entitled '*The Key to Prosperity: Science and Technology*', and it marked the start of en extended process of science reform in New Zealand. Indeed, the view of the committee was that it was in science's best interest for the government to establish an arms-length organisation to hold the purse strings and to allocate money in a more disciplined way. All science organisations including universities and other

[18] This particular debate lasted throughout the 1980s and into the early 1990s until the CRIs were formed.

tertiary institutions, private companies, private research institutions and government research organisations like the DSIR would, ideally, bid for funds from a central 'purse'.

Previously, the DSIR's brief from the Ministry of Science was to improve New Zealand's technological competitiveness in partnership with industry. The problem was that the mechanisms to achieve this did not exist, and in fact, the Public Finance Act explicitly prevented the DSIR from investing in joint ventures. Effectively, this 'blanket legislation' prevented government departments from formal dealings with the commercial markets, greatly inhibiting the rate of technology transfer from this sector. Even if the DSIR had a technology that could be developed – it usually wasn't. Besides, there was no satisfactory structure to ensure that government funded science and commercial markets were able to co-operate and develop a technology together even if there was a perceived market.

Notwithstanding this, the DSIR had achieved some success, particularly in selling its consulting services to industry, although this came at a price because the (Labour) Government began to cut back on funding on the assumption that income from clients would make up the difference – the so called 'user pays' regime. While this sounded good in theory, the reality reported by scientists of the era was that industry was reluctant to pay for services it had hitherto enjoyed for free, and this together with sharply reduced expenditure on scientific plant and equipment caused the DSIR and the other publically funded research providers to become alienated from industry and stagnate.

Figure 4-2: Prime Minister Lange Announces State Sector Reforms
(Acknowledgement: Matapihi Archives. First published in the NZ Listener, 1987)

By 1988, yet another committee was commissioned to examine and report on the malaise affecting the nation’s science system. This time it was the turn of the ‘Science and Technology Advisory Committee (STAC), and they duly released their report entitled “Science and Technology Review: A New Deal”. The report found that more was required in reforming the science system, and the authors recommended making provision for three separate functions. It was suggested that the functions of 'advise and policy development', 'decision making and funding allocation', and 'science operations' should be established.

Following the STAC report, a ministerial task group was set up in November 1990 to advise the government on the best way to achieve this 'functional' split. In 1991, the task group duly reported in what the science minister[19] came to hail as a 'seminal document in the history of New Zealand science and technology'. The report advised that, in order to develop new structures for the provision of science, the Government needed to 'enact permissive legislation enabling the restructuring of existing science institutions as either profit or non-profit entities'. It was decided that the old departmental structure was no longer appropriate in the 'what's best for New Zealand' regime, and science should be given a corporate structure. The recommendation for the 'new structure' was the 'Crown Research Institute' (CRI), which were to be 'productive sector or natural resource-focused with a broad science base, vertically integrated, nationally based with regional centres, having a clear focus that does not necessarily overlap with other CRIs, and having no prescribed maximum or minimum size' (MoRST, 2002).

[19] A change of government in 1992 saw National's Simon Upton become the new Minister of Science.

The advice was taken, and CRIs[20] were established by an Act of Parliament in 1992 as government-owned businesses, each with a sector focus and a scientific purpose. The CRIs would be held at arm's length from the government but would be answerable to it. Governments would not, however, protect the CRIs financially by underwriting their liabilities. This spelt the death of the DSIR, and the axe finally fell on the 30th June 1992 after 65 years of existence, and the CRI was born. Notably, the days of going 'cap in hand' to the government for extra funds when the annual science budget inconveniently ran out before time were now over (Parker, 2002), a fact that would come to haunt the CRIs as time progressed.

As was envisioned by the 'Science and Technology Advisory Committee, the reforms brought clear separation between the policy makers, those responsible for the allocation of funds, and the actual providers of science. Under the new system, these roles were allocated to the Ministry of Research, Science and Technology (MoRST) now responsible for policy advice; the Foundation for Research Science and Technology (FRST) now responsible for allocation of

[20] The number of CRIs was reduced to nine with the Institute for Social Research and Development disestablished in 1995 due to a 'failure to achieve economic viability' (MoRST, 2002).

contestable funds[21]; and Crown Research Institutes (CRIs) who were to be the science and R&D providers. The New Zealand science system now looked like this:

4.2 The Role of the CRI

In 1992 an act of parliament established the CRIs and set out the overall purpose and operating principles for each CRI. Under the 'CRI Act, 1992', the CRIs became stand alone legal entities that were independent of the Crown. They were to exist under direct control of individual boards, which were formed to 'provide authority, stewardship, leadership, direction, and control'. Sections 4 and 5 of the Act set out the 'purpose' and 'principles of operation':

> 4. Purpose of Crown Research Institutes
> The purpose of every Crown Research institute is to undertake research
>
> 5. Principles of Operation
> (1) Every Crown Research Institute shall, in fulfilling its purpose, operate in accordance with the following principles:

[21] Although the FRST allocate the bulk (approx. 78%) of the Government's operational 'Research Science & Technology (RS&T) funds with the bulk (approx. 60%) going to CRIs, other funding agencies also allocate RS&T funds. These agencies include the Royal Society of NZ (RSNZ), the Health Research Council (HRC), the Ministry of Economic Development (MED), and NZ Trade & Enterprise (NZTE).

> a) *That research undertaken by a CRI should be undertaken for the benefit of New Zealand:*
> b) *That a CRI should pursue excellence in all its activities:*
> c) *That in carrying out its activities a CRI should comply with any applicable ethical standards:*
> d) *That a Crown Research Institute should promote and facilitate the application of –*
>   (i) *The results of research, and*
>   (ii) *Technological developments*
> e) *That a CRI should be a good employer:*
> f) *That a CRI should be an organisation that exhibits a sense of social responsibility by having regard to the interests of the community in which it operates and by endeavouring to accommodate or encourage those interests when able to do so*
>
> *(2) Every Crown Research Institute shall, in fulfilling its purpose, operate in a financially responsible manner so that it maintains its financial viability.*
> (Source: CRI Act, 1992, Sections 4 and 5)

Although CRIs were to continue with fundamental or basic research, a key objective of the restructuring was to improve the conditions for the transfer of research science and technology (RS&T) at the 'applied' end. This meant that while CRIs were to continue with a medium to long-term focus, most of their research would now be undertaken with an eye to an ultimate end use or application. Under the Act, CRIs were now called upon to promote and facilitate the application of the 'results of research' and 'technological developments'.

Effectively, the role of the CRI had moved from doing 'pure science' to one of producing 'science and technology of relevance to industrial end users' and CRIs were being encouraged to seek 'appropriate commercial arrangements' with the private sector (MoRST, 2002; Science and Technology Advisory Committee, 1988).

However, while the CRI Act cleared a pathway for the newly formed CRIs to pursue the development and transfer of technology, and engage in commercial arrangements with industry, it did not automatically follow that they would be successful. Indeed during these early days, the MoRST realised that CRIs would face difficulties in developing and transferring technology, conceding that the 'constantly developing and changing nature of science and innovation' occurred in a 'complex environment that is both national and global' (MoRST, 2002, p.9). Moreover, political commentators and economists continued to note that New Zealand's economic growth was not keeping up with its trading partners, or with nations that were seen as competitors. Indeed the media regularly regaled politicians and the science community with statistics that showed New Zealand's slide down the OECD ratings, falling from 9th for per capita GDP out of 24 nations in 1955 to 20th out of 29 nations by 2000 (MoRST, 2001c). Further, NZ's exports continued to be dominated by low value commodities (refer Table 4-1) while New Zealand's trading partners were applying technological innovation and developing high-value goods and services – and raising the standard of what they produced and how they worked. By comparison, in 1997, 49% of New Zealand's R&D used in manufacturing continued to be low technology, compared with 11%

for Australia and 4% for the OECD average (MoRST, 2001c), and this trend showed no sign of improvement.

Sector	1999	%
Dairy	1,862	17.9
Meat	2,874	13.3
Wool	754	3.5
Fish	1,249	5.8
Horticulture	1,547	7.2
Forestry Products	2,446	11.3
Aluminium	873	4.0
Machinery and Transport Equipment	1,687	7.8
Other	6,296	29.2
Export of Goods	21,588	100

Table 4-1: NZ's Reliance on Commodity Exports ($Million)
(Source: BERL Forecasts, 2000)

The global and competitive environment was now having a marked effect on the New Zealand economy, and to make matters worse, the post-reform practice of "user-pays" had dampened much of the collaborative activity that had formerly existed between CRIs and the private sector. Something had to be done about New Zealand's economic malaise, and the Government determined that fostering collaborative relationships between CRIs and the private sector was the solution.

4.3 The Push for Collaborative Relationships

By 1997, five years after establishing the CRIs, the New Zealand Government created Technology New Zealand. Its raison d'être was to increase the opportunity for New Zealand firms to apply innovation and technological learning to promote technology transfer. It showed that the Government was no longer content with 'science outputs', but rather, had identified a need to invest for 'science outcomes', and was now actively 'steering' the CRIs toward increasing their engagement with the private sector. For the Government, innovation and inter-firm relationships would enable new technologies to be developed, and the exchange of technological knowledge would provide firms with the ability to adopt new processes or develop new services. Effectively, the CRIs were now being encouraged to focus on building external market relationships so that the innovation needs of the New Zealand economy could be identified, stimulating technology transfer and commercialisation activity, and driving economic growth.

However, simply having a network of R&D institutions willing to engage with the private sector was not enough. Business-to-business relationship development did not seem to be happening automatically and the Government soon realised that it needed 'purpose built' funding mechanisms to incentivise collaborative relationships between the CRIs and the private sector. This was perhaps hardly surprising because, after all, most scientists are not used to selling their ideas or pursuing in-market opportunities, preferring instead the more controllable and predictable lab environment, whereas many in the private sector held the view that working with CRIs was complicated, time consuming, and expensive. To address this, the 'Technology for Business Growth' (TBG) scheme was launched, and unlike previous schemes, it was specifically designed to encourage technology transfer by co-funding firm R&D activity – which usually required a relationship with a CRI. Thus, in addition to facilitating inter-firm technical collaboration, the TBG scheme had the added benefit of helping build business enhancing relationships by exposing the CRI technologists to the commercial realities of the market place.

Indeed, the MoRST was so convinced of the economic benefits of public and private sector collaborative activity that in a subsequent evaluation of the TBG scheme it concluded that five factors were vital to successful collaboration (MoRST, 2001c):

1. Selecting the right collaborative partner;
2. A clear understanding of each partner's responsibilities and tasks;
3. Common goals with no hidden agendas;
4. Mutual trust and respect amongst partners; and
5. Top managerial commitment from all parties.

Thus, by 1999, the Government had come full circle. It now saw its role as sustaining the New Zealand innovation system by supporting networking and collaboration in the research and innovation community (MoRST, 2001a). Moreover, it had moved from merely funding 'science' to funding collaborative R&D activities and relationships, and as a result, the expected increases in technology innovation and transfer were seen as finally putting New Zealand on the path back to the top half of the OECD rankings. Indeed, the OECD had already given its tacit approval to Government policies that emphasised joint research activities and other forms of technical collaboration between firms and public sector institutions (OECD, 1997).

However, improving the rate of technology transfer by simply encouraging the establishment of collaborative relationships was not the economic panacea that was hoped for. The Government had several reasons to come to this conclusion. In the first instance, both the public and the private sectors in New Zealand were investing less in R&D than the OECD average, with New Zealand firms contributing only 34% of the total national R&D effort – lower than almost all other OECD countries and one-third of the OECD average (MED, 2003). While this statistic could in part be explained by the fact that the 'typical' private firm in the OECD is a large manufacturer, where New Zealand firms tended to be small scale, it nevertheless pointed to the fact that New Zealand firms did not appear to be *actively pursuing* R&D as a means to economic growth, leaving the CRI to take the lead in developing New Zealand's technological capabilities. The difficulty here was that the CRIs had already demonstrated a limited ability to collaborate and this, coupled with the high transaction costs associated with doing business with the CRIs, was off-putting to potential R&D partners.

Secondly, it was considered by many in the business community that the private sector, rather than the CRIs, would ultimately drive the demand for new ideas and technologies, and find market niches or carve out new markets. What the private sector required was an ability to identify and develop ideas, build on them, and translate them into marketable products. Consequently, private sector firms could not be expected to be concerned about the wider innovation system, but rather with their ability to find innovative solutions to remain competitive, and an ability to identify and exploit technological knowledge from the wider environment in an efficient way. Unfortunately, these abilities were not evident. The Government's Technological Working Group[22] had identified a number of barriers to technological innovation, and had noted that New Zealand firms:

1. Lack recognition of technology as a key element in business strategy;

[22] The Technological Working Group was established by the Government in 1996 to examine the barriers to technological innovation in NZ.

2. Are unable to identify technological problems and opportunities;
3. Lack objective information about technology and technology services; and
4. Are unable to articulate technology requirements;

Thirdly, and perhaps most alarmingly for the Government, was that investment in CRI science capability development was not being converted into an ability to develop and transfer technology. Indeed, the Government's 'Science and Innovation Advisory Committee' were of the view that the CRIs "appear to have difficulty with the R&D process" (Science and Innovation Advisory Committee, 2001, p. 30), and at the same time the Ministry of Economic Development was noting that the CRIs "require better connections with business to support increased commercialisation of R&D" (MED, 2003, p.45). This was a problem for the Government because technology transfer is concerned with the use by people of technology or technical information developed by other people, and if the CRIs were struggling to achieve R&D outcomes, and were disconnected from their 'market', then the conditions for technology transfer, and subsequent economic growth for New Zealand, were unlikely to be met. No doubt the observation by Professor Michael Porter that "there is very little evidence yet that innovation within New Zealand has kicked into high gear"[23] was ringing alarm bells in public and private sector circles.

It was no surprise that, by 1999, the MoRST had concluded that the barriers to technology transfer in the New Zealand science system 'were still evident to a large degree' and that 'upgrading New Zealand's ability to innovate and absorb change is now more critical than ever' (MoRST, 2001d). Increased competitive pressure and rapid technological change was now forcing firms in both the private and public sectors to innovate more rapidly, and because technological capability and capacity were seen as 'crucially important to New Zealand's international competitiveness and economic well-being' (MoRST, 2001c, p.2), the Government was once again forced to re-examine its technology policies to support New Zealand's economic goals. New types of policies were needed to address 'innovation systems failure', and in the case of enhancing the technological capability of the CRIs, this meant improving their ability to access the appropriate networks, to identify relevant technology and information needs, and to adapt such knowledge to their own R&D activities.

[23] This remark was made to the NZ media by Professor Porter during a 1988 visit to NZ while conducting a study of International Patenting Activity

4.4 Knowledge: A New Source of Advantage

By 2000, a new term had crept into the economic parlance of the public and private sectors. Quite suddenly, the concept of "knowledge" had become the central protagonist in the nation's quest for economic revival, being at the very heart of discourse on the need to develop more globally competitive products, processes, systems and services. Indeed the public could have been forgiven for thinking that every media release, discussion document, report, or policy emanating from Government concerned the criticality of New Zealand becoming a 'knowledge society'. For the Government and their advisors, the 'knowledge economy' was the new game in town, and developing 'technological knowledge' had become the new panacea for New Zealand's economic woes. And just like the emphasis placed on *technical relationships between firms* that came before it, the OECD was once again in the vanguard, referring to knowledge as the 'core element in the emerging mode of production' and embracing knowledge and information as the 'key drivers of future productivity and economic growth' (OECD, 2000, p.11).

Significantly, many of New Zealand's trading partners were already operating as 'knowledge-based economies' have recognised the place that knowledge occupies in modern economies. As a result their knowledge-based industries were growing faster than industries on average, and consequently, they were channelling more and more resources toward the production of knowledge as a way to add value to production (MoRST, 2001b).

For New Zealand's Minister for RS&T, New Zealand was 'on the brink of a period of profound change' because 'all that we do, all that we make, and all that we earn will be altered by new knowledge and technological change' (Minister of RS&T, Statement of Priorities, Government Notice for the Purchase of Public Good Science and Technology, 1999, P.2). Against this background, it was determined that creating a knowledge society required a new strategy, and in 1999 the Minister lunched the 'Blueprint for Change', which at its core was 'focused on exploiting knowledge for New Zealand's future prosperity and well-being' (MoRST, 1999, p.1). For the Minister:

> "The world economy is undergoing significant change, with an increasing emphasis on the ability to create, store, distribute and apply knowledge. For New Zealand, the successful development of a knowledge society will involve moving to systems, services and products with higher levels of value added by knowledge" (p.3).

This ready acceptance by the public sector that knowledge was important to the economy was creating pressure on the MoRST to alter its policy position, and while continuing to promote inter-firm relationships, it now sought science outcomes from the CRIs that generated new knowledge and firm technological capability. For the MoRST, technology had become *the key driver* for knowledge societies, and the Ministry was now stressing the importance of technological knowledge for developing and applying new knowledge-based processes and technologies. The expectation was that developing CRI technology transfer capability would provide New Zealand with the means to be competitive in a globalised economy.

Figure 4-3 highlights Government policy changes that occurred from the inception of the CRIs in 1992, bringing CRIs to a point where, in theory, the conditions for effecting successful technology transfer were in place, or at least had evolved to a point where the CRI was empowered to 'get on with the job'. Science 'outcomes' had become technology transfer 'outputs', relationships with the private sector were now encouraged, and technical knowledge - the CRIs 'stock-in-trade' - had become a marketable asset. Seemingly, all the CRIs had to do was develop technology transfer strategies and plans that matched their science and technical capabilities.

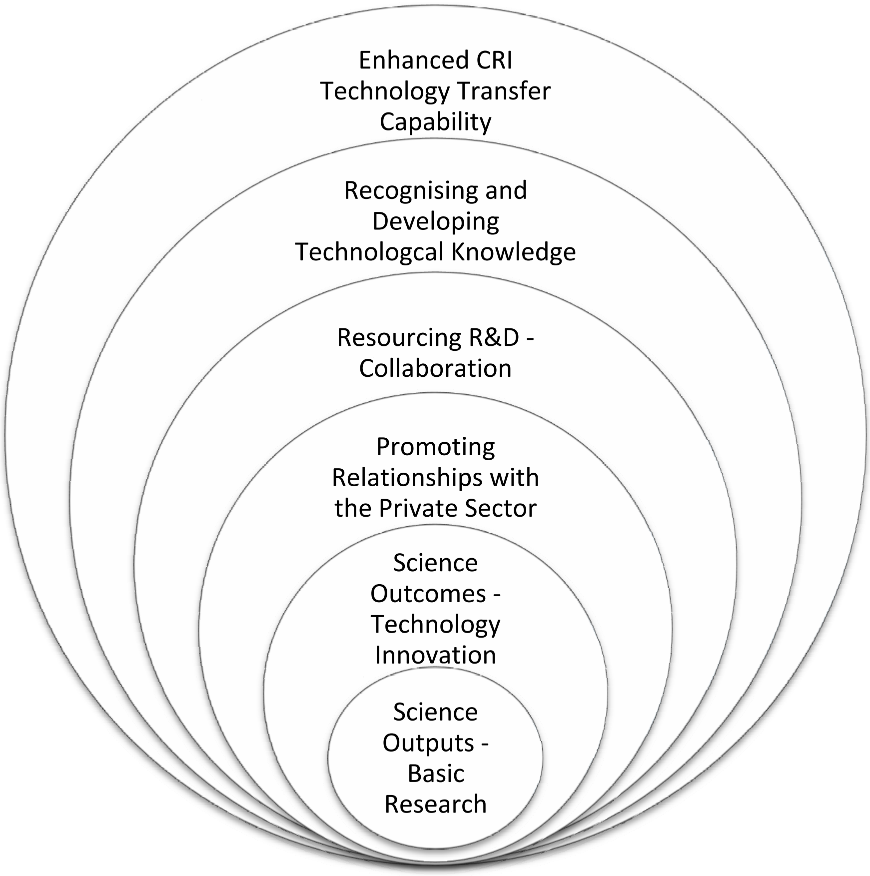

Figure 4-3: The Evolution of CRI Technology Transfer Capability

4.5 Impediments to CRI Technology Transfer Capability

The idea that Government RS&T policy promoting 'relationships' and 'knowledge' would automatically increase the ability of the CRIs to innovate and transfer technology was not one that had a basis in fact. While it was true that much had been done to focus public research investment on industrial end-users and on improving access to the results of publicly funded research, the new technology policies did little to transform the way in which R&D was organised, or improve the way technological knowledge produced within individual CRIs. In short, increasing the rate of technology transfer continued to be problematic for the CRIs.

Where previously the focus for science had been on delivering ‘public good’, the Government now required CRIs to demonstrate ‘adequate organisation of knowledge communication’ between themselves and firms, and ‘mobilise, co-ordinate and integrate different types of knowledge’ (MoRST, 2001c, p. 2). Effectively the CRIs were being encouraged to enter into collaborative relationships with industry and other end-user communities, with a view to stimulating the production of applied technological knowledge, which when applied to increasing firm productive capacity, would maximise the return on investment from the public purse. CRIs, apparently, could do more to add value to New Zealand industry by utilising technological knowledge to develop and transfer technology, and so doing, drive economic growth through the expansion of knowledge-intensive industries.

4.5.1 Old structure – new environment

The new policy and funding environment presented the CRIs with a number of problems, each of which impacted on their ability to innovate, develop, and transfer technology. In the first instance, the traditional structure of the research organisation differed from that which was now required to meet the lofty expectations of Government. Indeed, for the Royal Society of New Zealand

> "A considerable disjunct exists between what may optimistically be expected of a science system and the actual conditions and restrictive structural pressures under which it operates" (Royal Society, 2005, p. 1). "The Road Ahead"

Historically, research organisations tended to be structured around scientific disciplines so that science discovery could be produced from fundamental or basic research. This was certainly the case with the CRIs, and policy changes and new market-based resourcing opportunities were not going to change that – at least not in the short term. Science outputs (i.e. science discovery) had become science outcomes (i.e. technological knowledge), and these outcomes would, according to the Government, be best achieved through pro-active market engagement, collaborative relationships and the development and transfer of technology and technological knowledge. In many ways, the CRIs were being asked to find a new modus operandi, but without the benefit of a clearly defined pathway to follow – or the management resources and skills to do so.

Secondly, like most large organisations, CRIs are complex systems of human activity formed by the intersection of human actors, organisational structures and the environmental context in which they operate. Now that productivity and economic growth were being associated with increasing the rate of technical progress and the accumulation of knowledge, the CRIs needed new structures to facilitate the capture of innovative thinking and organisational technological knowledge. The CRIs now needed to find, develop and transfer technological knowledge, but this depended on:

- Their stock of knowledge;
- The people who generated knowledge - and who learnt how to use and exploit it;
- An environment where people can share knowledge.

The difficulty for the CRI was that relevant technological knowledge and skills would always be shifting due to changing technology, market conditions and management strategies, and technology transfer success now depended on the ability of the CRIs to identify, develop and apply new knowledge and skills faster than their competitors. However, identifying technological needs, responding to changing market conditions, and developing management strategies required resources and skill sets that were not usually found in the traditional science organisations. Now the CRIs were finding that operating in the new environment required an ability to meld the science and technical function with the marketing and commercial function so that new technological knowledge could be captured, developed, and transferred with *and* for end customers.

4.5.2 Lack of resources for technology transfer

When the CRIs were first established, it was expected that as much as 90% of their revenue would come from the FRST. However, by 2006 they received only about 50% of their revenue from the FRST, nearly all of which was contestable, with the balance coming from short term consulting work. Additionally, most FRST contracts for RS&T lasted 3 years, yet often basic research projects exceed 8 years duration, and as a consequence, CRI cash flows and funding resources are unstable.

The contestable nature of funding presents significant resourcing issues for the CRI. Firstly, it makes it difficult to provide a stable employment environment in order to attract quality staff, because in a highly contestable system, new R&D projects may not be available to provide continuing employment – leaving the CRI to carry un-funded staff between projects, or to recruit project staff on short term contracts. As one CRI noted, contestable funding may be appropriate for projects that aim to generate new scientific knowledge, but for projects where economic outcomes are the objective, contestability should be at the organisational level rather than the project level.

For the CRI, contestability also involves high transaction costs and does not support the capability underpinning a technology / knowledge acquisition partnership with business, 'placing CRIs in a largely consultative role in short-term projects with no room for capacity building or science investment' (RSNZ, 2005, p.6).

Secondly, while the 'discovery' and 'commercialisation' stages of technology transfer are able to attract funding support from the MoRST, the 'development' stage - because it has no obvious saleable value, is not. Consequently, scientists and technologists viewed the technology 'development' phase as something of a poor cousin, and not surprisingly, lack of resources means that many 'discoveries' fail to progress through the 'development' phase – the so called 'valley of death'.

From the scientists' perspective, the challenge for technology transfer was funding 'development' without draining resources from the discovery and commercialisation phases. Indeed, if resources were directed towards 'development', then it may well be at the expense of science discovery which, in turn, had implications for future innovation. This state of affairs prompted the Royal Society of New Zealand to declare that:

> "While scientific innovation has been allocated a central role in improving the nation's economy, our scientific institutions have been funded under a model that does not adequately support the research that is capable of addressing these issues"

and further that

> "Both the funding model and the consequential organisational structure will lead us to fail in terms of our ability to enhance innovation capacity, and convert science into applied technology" (Royal Society, 2005, p.3).

For the CRI science community , this lack of development resources contrasts with competing technology innovation companies who often spend over 15% of their revenues on R&D (Jordan and Atkinson, 2003), which reduces earnings, but ensures ongoing potential to produce new technology products – thereby increasing the value of the firm. Indeed, the experience of many scientists was that outstanding science and successful market innovation often go together (Mansfield, 1991).

Notably, nothing in the Act specifically requires CRIs to fund the technology 'development' phase though it was often assumed that public good science funding (PGSF) would provide adequate resources when in fact it does not.

> "The problem is that development' funding is expected of CRIs by Government and, unfortunately, the private sector. This expectation poses a number of problems for New Zealand science, not the least of which is exactly that this expectation may with-draw funding from 'discovery' running down the science infra-structure" (Jordan and Atkinson, 2003, P.92).

Moreover, for many scientists, the argument that if diversion of resources from 'discovery' to 'development' does occur, it may well be misspent because the

PGSF dollar allocation is not enough to fund development to useful outcome, and discovery half-developed from a commercial viewpoint is almost as useless as something not developed. The overriding argument from scientists is that urgent attention needs to be given to funding 'development' – but not by depleting 'discovery'. Yet despite these arguments, the Government continues to be unwilling to fund development (Royal Society, 2005), even when their own publications refer to 'development' as the 'valley of death'.

4.5.3 The need for marketing resources

An important part of the rationale for restructuring the science system was to create providers who would be more commercially focussed. However, while there is agreement that CRIs have had a degree of commercial success (MoRST, 2002), there is acknowledgement that variability exists among individual CRIs as to their commercial focus.

Thus while some CRIs are able to say that they have

> ".....developed a significant ability to protect and exploit intellectual property, including patenting and licensing, entering into joint ventures and spinning out companies",

others feel that they need better guidance on commercialisation

> ".....a lot of patents return no significant commercial value yet CRIs get brownie points for numbers of patents – this may not be the beast way of capturing benefit from IP" (MoRST, 2002, p. 36).

For marketers however, gaining an intellectual property position does little to transfer and commercialise technology. Quite apart from the high costs to maintain an IP position - and the even greater costs to defend it in the global market - there was no guarantee that it had any value to the market, and in many instances became a significant and ongoing drain on CRI resources.

To enhance their technology transfer capability, the challenge for CRIs became one of improving their ability to gain access to industry networks, and to develop technological solutions to customer and supply chain problems. In this way, commercialisation opportunities are enhanced simply because customer needs are being identified and met. But this too, has proved a difficult task because the scarcity of resources for technology development is matched by a scarcity of resources for marketing effort, and lack of marketing resources (funds, knowledge, and expertise) prevents the CRIs from connecting their technological knowledge and capabilities to end-user problems and opportunities.

As could be expected, the lack of marketing resources has not gone unnoticed by the MoRST, who suggested that CRIs require a 'general upgrading of technical, managerial and organisational capabilities' (MoRST, 2001c, p.5). Put another way, it is one thing for CRIs to focus on becoming knowledge-based businesses capable of providing research and technical expertise, but it is quite another, however, to identify and rapidly exploit the commercial opportunities that might flow from this technological knowledge. For the CRIs, the lack of resources for marketing activity means that:

1. Network and customer based opportunities are not identified and quantified
2. Commercial relationships are not established
3. Opportunities for technical collaborations are not being explored
4. Technology 'value propositions' are not able to be developed, and as a consequence
5. Technology transfer rates remain low.

Without adequate resources to engage with the market, the CRIs face the difficult task of identifying and developing technological solutions to industry problems – but without the industry relationships or the intimate knowledge of industry problems that are required to provide *marketable* technology solutions. Indeed, an OECD review of innovation in New Zealand led to the statement that "lack of management, marketing and distribution skills appears to be a major impediment to innovation", and further that "CRIs need to put more effort into their relationships with both commercial and research partners" (OECD Review, 2007, p.12).

Naturally, the need for marketing resources also places strain on the resource requirement for the technology innovation and development phases, bringing with it a need to balance the needs of science with those of marketing. For many CRIs this resource ‘balancing act’ and the requirement to accommodate differing objectives can result in competitive tension and distrust between the two functions, doing little to promote cross-functional collaborative effort and knowledge transfer (refer Figure 4-4). For the MoRST, this difficulty in ‘juggling the science *and* the business’ comes down in many cases to the perception that a vacuum exits in terms of the structures and staff that have the right mix of science and business skills and understanding, and even when they do exist, often the expertise is from unrelated areas. A good example is the promotion of scientists into marketing and commercial roles (MoRST, 2002).

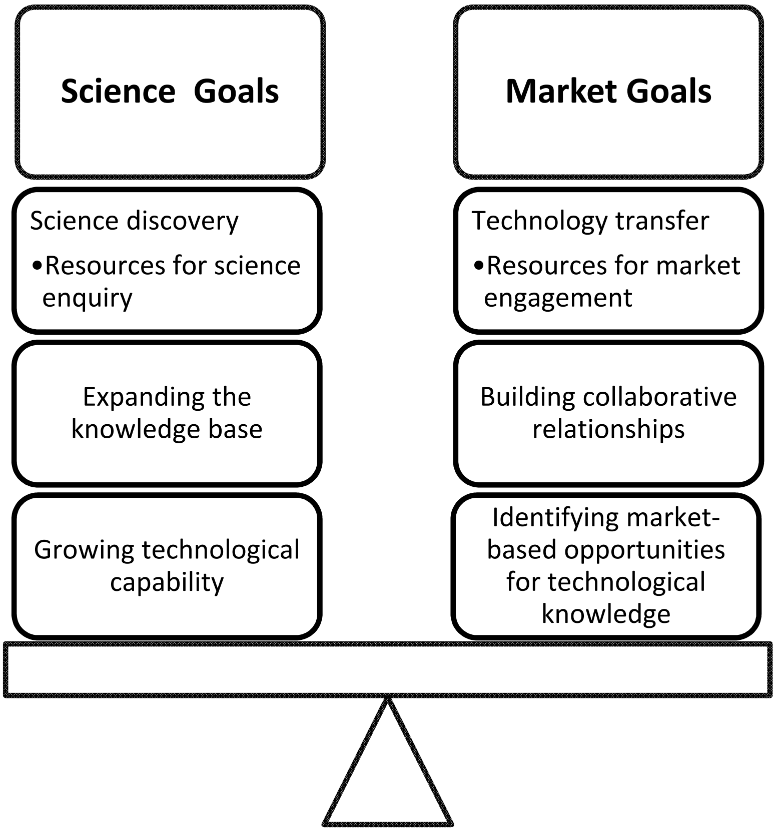

Figure 4-4: Balancing Resources for Technology Transfer

Many scientists blame the tension between 'science' and 'commercial' on the government, citing policy aimed at reforming the science process by targeting short-term revenue generation over capability and skill building, creating 'uncertainty in the science role of CRIs' (Royal Society of New Zealand, 2005, p.5). In contrast, the Government, backed by the OECD, continues to call for CRI performance indicators to be based on the impact of their research and their technology transfer activities. For the Minister of RS&T:

> "Scientists must have access to business skills, which are critical in developing new technologies into marketable products";

and further that:

> "To improve the international competitiveness of New Zealand's enterprises we must support research to develop new technologies, the skills for applying these technologies, and the processes for capturing value from commercialising these technologies" (Hodgson, 2001).

Nevertheless, whether one takes the position of promoting science or commercial goals, the relationships between science and technology are complex and differ greatly from field to field. This is true of the CRIs, where the 'diversity of strategies, platforms, processes and activities that comprise the science-marketing interface suggest that no one approach to technology transfer will necessarily be optimal for all' (Bojesen-Trepka, 2004). The point is that science, isolated from the world of practice, is fruitless (Kealey, 1997). Indeed, in many instances, technological development leads the initiation of scientific research – even to whole new scientific fields, rather than then other way round. As examples, the field of metallurgy arose because steel became an important economic commodity, solid-state physics became an important field of research after the birth of the transistor, and computer science came after computers. Basic research has also played an integral role in the growth of national economies. For example, even though only 15% of the total R&D in the United States falls under this category, that small percentage has dramatically improved lifestyles and technologies. Such advancements as lasers, x-rays, and semiconductors can all be traced back to basic research.

Perceptibly, the key for scientists is to keep the knowledge base growing through basic and applied research. For marketers, the key is to identify useful technologies and technological knowledge that matches current - or future - market needs. This can create value for the firm, and can facilitate the development of collaborative relationships and further R&D. In this way, each new discovery can provide a platform for further discoveries. The challenge for the science / marketing interface is to determine marketing's role in this process.

In summary, it is fair to say that CRIs achieved much during the first decade of their establishment. While the Government's main focus over this time had been on ensuring that they operate as commercial entities, the CRIs have grown, delivered high quality science outputs, provided a return on the Crowns capital investment, and generated significant economic and social benefits. Despite this, questions about their overall contribution and impact remain. Various stakeholders would like to see more. The Government continues to place more emphasis on science as an important driver of economic progress, and no matter how well CRIs have done, they could do better (MoRST, 2002).

Section Two: The CRI Case: Introduction to the firms

Although CRIs trace their roots to the more classical 'scientific research institution', they no longer operate as 'stand alone' research providers, but rather function as important nodes in a complex network of up and down stream industrial customers, suppliers, service providers and competitors. It is within this dynamic and competitive environment that CRIs present their R&D capabilities and technologies to multiple private and public sector audiences.

This is not an easy operating environment for the CRIs because increasing commercial imperatives demand increasing levels of market engagement and collaborative relationship development, and this takes place against a backdrop of high R&D and marketing costs, resource constraints, and the ongoing requirement to produce a return on investment at least equal to their cost of capital. Couple this with the need for cross-functional competencies to integrate and coordinate technology transfer activities, and for CRIs, managing the process of technology transfer has become a challenging and difficult issue.

Moreover, since 2002, strategic recognition of the ‘knowledge economy’ has caused each CRI, without exception, to reinvent and reposition their science ‘platforms’ and technical ‘capabilities’ in order to take advantage of new and emerging scientific and commercial opportunities. As a consequence, the CRIs have come to realise that, to remain competitive, technology transfer now equates to a need to achieve competence in:

1. Knowledge capture;

2. Innovation processes;
3. Technology development;
4. Technology commercialization and diffusion processes, and;
5. Internal and external relationship development.

For the CRIs, the task of developing these competencies has seen each CRI adopt distinctly different approaches to innovation and technology transfer practices, perhaps due to their origins as R&D providers in different industry sectors[24], each with their specific requirements. As a consequence, each CRI has evolved separately, and has developed a distinctly different culture. Each also pursues diverse science objectives and commercial strategies with varying levels of resource, and each operates in different (but increasingly over-lapping) external networks. Nevertheless, despite the differences in the contextual nature of their R&D activity and their 'acceptance' commercial imperatives, improving the rate of technology transfer continues to be highly problematic.

[24] For example, Forest Research (Scion) was aligned with the forestry sector, HortResearch with the Horticulture sector, AgResearch with the agriculture sector, IRL with manufacturing and heavy industry, Crop and Food with cropping and food production, and NIWA with climate, water & atmosphere.

4.6 AgResearch Ltd.

Like all CRIs, the New Zealand Pastoral Agriculture Research Institute (AgResearch) was established under the Crown Research Institutes Act in 1992. Despite its origins being a mix of agricultural science endeavour from various Government departments, by 1995 it had grown to 5 divisions, comprised 700 scientists plus 340 farm and support staff, and had transformed itself into a research institution with an international standing.

<table>
<tr><th>Division:</th><th>Divisional Goal:</th></tr>
<tr><td>1. Dairy and Beef Division</td><td rowspan="3">Seek to improve the product range and quality, and profitability of each sector</td></tr>
<tr><td>2. Sheep, deer and equine Division</td></tr>
<tr><td>3. Forage plant improvement Division</td></tr>
<tr><td>4. Animal health Division</td><td>Focused on improving product quality, market access and livestock productivity</td></tr>
<tr><td>5. Sustainable Production Division</td><td>Focused on integrating farm production technologies within sustainable production systems from information generated from within and outside the institute</td></tr>
</table>

Table 4-2: AgResearch Divisional Goals, 1995
(Source: AgResearch Annual Report 1995)

As early as 1995, the institute had noted that their operating environment was changing. Apart from projecting a decline in PGSF funding, AgResearch had noted a move toward global free trade, and an international explosion in biotechnology advances which offered enormous potential for the development of new technology products. In this new environment AgResearch intended to be 'less a passive partner in research, and more of a catalyst for change', and began matching technology with new market opportunities through collaborative relationships.

Technology innovation

From its inception AgResearch had business goals that included the development and management of intellectual property, and undertook technology development and transfer activities in the food, fibre, biotechnology and other industries based on pastoral agriculture. By 1995 it was predicting that non-PGSF sources represented the greatest long-term opportunity for growth, with revenue from commercial sources expected to increase as commercial organisations adopted new agri-technologies and biotechnologies to exploit new global opportunities offered under GATT and other liberal trade agreements.

The early recognition of the importance for increasing innovative capacity saw the company create whole new areas of competitive international business, which focused on five major areas of innovation

1. <u>Gene Products</u>: innovations from human and agricultural genes;
2. <u>Nutraceuticals:</u> innovations in naturally occurring bioactive agents;

3. Animal Health: innovations that help farm animals to thrive;
4. Processing Solutions: innovations that add value to food and agricultural products during processing;
5. Analytical Services: innovations that provide valued information for the agriculture sector in New Zealand.

In each of these focus areas, AgResearch aimed to build new spin-off entities and an international reputation as innovators of new products and technologies, and by 2001 had enjoyed some success. Figure 4-5 shows the ratio of AgResearch's commercial revenue as compared to PGSF funding.

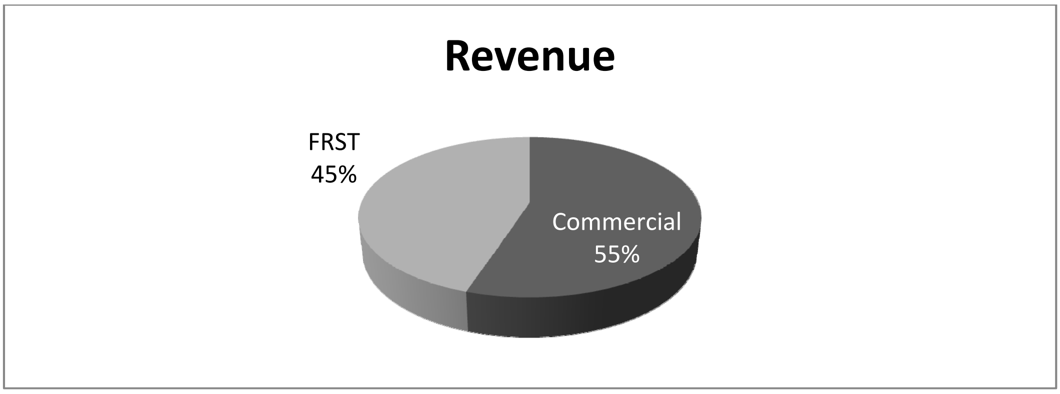

Figure 4-5: AgResearch Sources of Revenue, 2001
(Source: AgResearch Annual Report, 2001)

Notably, even where commercial revenue was growing, the company continued to use the traditional science organisation measure of innovation – that of 'scientific publications', and year on year continued to report science staff publication numbers, as shown in Table 4-3.

	1995	1998	2003	2005
Refereed Journals	378	229	248	591
Conference Papers & Abstracts	393	267	301	246
Books & Book Chapters	44	28	17	29

Table 4-3: Measuring Innovation Potential: AgResearch scientific publications (Source: AgResearch Annual Reports)

Technology transfer

By 1998, structures for developing and assessing technologies were in place, although these 'structures' were less to do with the management of internal technology transfer practices, but rather were concerned with the establishment of joint research companies and joint ventures. Nevertheless, AgResearch was responding to potential national and global demand for agriculture based technology products, and was expanding the emphasis of its research operations 'closer to market identification and development'.

More significantly, the institute established a series of 'technology development units' (TDU's) as a way to improve the interface between science and industry in the development and transfer of technology. Its ultimate intent was to 'generate substantial revenue' by collaborating with clients to transform the results of scientific research into 'technologically sophisticated products and services. For Chairman Neil Richardson, achieving client relevance and financial strength required AgResearch to 'work more closely with the end users of the company's knowledge – the commercial sector'. AgResearch's 'scientific engine room', supported by research collaborations, was now focussed on the market application of new technologies

However, while the TDU's had some success developing and transferring technology, by 2000 the company had begun to look for better ways to create value from its technological knowledge. This led to the set up of 'Celentis' as *the* business arm of AgResearch, with the intention that it would secure a position as a provider of key technologies for new discoveries. Effectively, Celentis had replaced the TDU's as the commercial vehicle for the company's technologies and intellectual property, and like the TDU's, its brief was to work closely with customers to identify business opportunities and to ensure that scientific research led to the development of products of significant value. Indeed the central objective for Celentis was the formation of strategic alliances with national and global industry leaders, with the expectation that AgResearch's products would be appropriately delivered to lucrative international markets. For the board and the management team, Celentis was the vehicle to 'bring a commercial philosophy' across AgResearch's entire operation, and represented a transformation in AgResearch's approach to product development. Indeed, it was planned that product development would now be accelerated because Celentis was to re-invest its profits back into opportunities arising from AgResearch's science.

For Celentis, the business model now accommodated an 'awareness of science innovation' that, based on market relationships, would lead to commercialisation of a technology product. According to the business model, shown in Figure 4-6, Celentis had the structure and the ability to 'drive an idea through to the marketplace'.

The rapid and successful commercialisation of technology has long been considered the 'holy grail' for research institutions, and with the potential for success in technology transfer through its wholly owned subsidiary Celentis, AgResearch now considered itself well placed for future commercial growth.

> "We have launched five new subsidiaries over the past year and now have a much better link between our product pipeline and market opportunities", (Stewart Washer, CEO, Celentis).

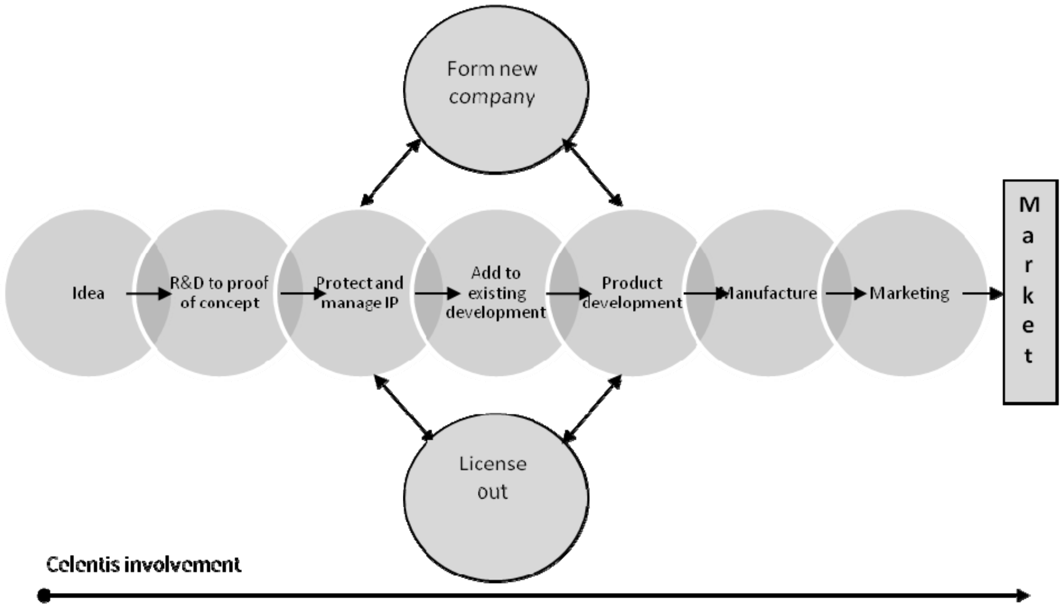

Figure 4-6: Celentis Technology Transfer Model circa 2003
(Source: Celentis)

But it was not all plain sailing for Celentis. A survey by senior management revealed some significant technology transfer capability deficiencies. In particular, the review noted that:

1. Celentis capability in science commercialisation scored 4 out of 10. This process focussed on capabilities such as:
    - The process of taking a science concept through the product development process
    - The process of launching new products through subsidiaries and investments
    - The process of collecting and using market intelligence in a timely manner

- The process of aligning science with the market
- The process of protecting and managing intellectual property.

2. Celentis capability in establishing new business arrangements scored 5 out of 10. This process focussed on capabilities such as:
   - Establishing new start-up companies
   - Negotiating partnerships with larger industry players
   - Establishing license agreements
   - Valuing intellectual property and businesses and scenario analysis.

3. Celentis capability in investment management scored 4 out of 10. This process focussed on capabilities such as:
   - Managing businesses
   - Investment management
   - Arranging Finance
   - Analysing risk – portfolio management
   - Negotiation
   - Forming and managing strategic relationship

These were serious capability gaps, and in addition to other identified weaknesses in respect to a perception that Celentis lacked commercial focus[25] and that the competitiveness of its intellectual property was questionable. This together with under-developed linkages between other research institutes, investors and businesses caused the AgResearch Board and executive to ‘refine’ their approach to technology transfer by reintegrating much of Celentis’s core commercial services back into the parent company.

Thus by 2005, new CEO Dr. Andrew West had reintegrated the business development and intellectual property management capability into the commercial services team with commercial staff “better aligned to the science groups” and hence better able to service their commercialisation needs through “rapidly transferring exciting new technologies to market”.

Like Celentis, the aim of ‘commercial services group’ is to rapidly identify new technologies and move them to market by transferring the new technologies to existing businesses by establishing new trading entities alone or in partnership with external partners; by licensing technologies to third parties best able to get

[25] Notably, Celentis had a number of intellectual property specialists, and banking & finance specialists – but no specialist marketing personnel.

them to market; or via joint development projects with external clients who will own the technology going forward.

In contrast to the earlier Celentis model, the increased commercial focus by AgResearch points to an approach to technology transfer that had an expectation that significant science would produce conditions for technology development, but more particularly, placed greater emphasis on joint development and collaborative relationships with customers and market networks. This new approach to technology transfer is represented in Figure 4-7.

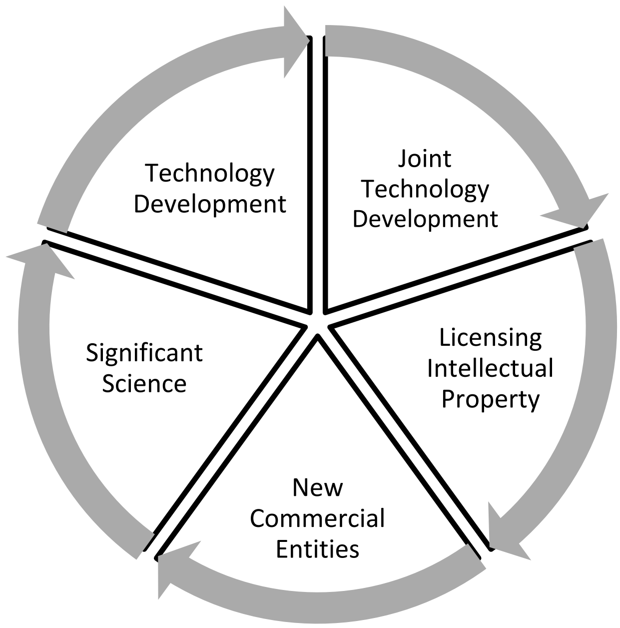

Figure 4-7: AgResearch Technology Transfer Model circa 2005
(Source: Adapted from AgResearch Annual Reports, 2004/05)

Unfortunately, technology transfer is not that prescriptive and marketing questions remain unanswered. Despite the new approach to technology transfer, questions still remained. In particular, who will gather and make sense of market knowledge and communicate this to the scientists so that individual and sector technology value propositions can be developed; how will the company's developing technological knowledge be promoted to prospective customers in non-traditional sectors; and who will be responsible for customer relationship development and management?

4.7 New Zealand Institute for Crop & Food Research Ltd.

As a CRI, Crop & Food Research is an independent government-owned company providing research, technology, and services to support the development of technology products, derived from grain, vegetable & flower crops, and from seafood. It beginnings were with an 'establishment board' that was tasked by the minister to with assess the land and buildings formally associated with the DSIR in advance of it being formally established as the 'crop' CRI. Indeed, before it officially became a CRI in July 1st 1992, it was being referred to as the CRI of "Fish, Chips, and Petunias" reflecting the mix science areas it was ultimately to be associated with.

Even in these formative stages, reports were being prepared for research studies and market opportunities, and it became clear to the 'establishment board' that the Fish, Chips & Petunias CRI would "be in a position to cover a wider range of industries and technologies than was previously possible in any of its component parts.....especially in the area of technology transfer"[26] With less than three months until the new institute was to be up and running a new name was approved by the shareholding ministers, and the 'New Zealand Institute for Crop & Food Research Ltd.' officially came into being.

By 2002, ten years after its formation, the company had grown to more than 330 staff in New Zealand and Australia, and had developed expertise in nutritional science, food biochemistry and processing, postharvest technology, physiology, plant breeding, molecular biology, and sustainable crop management. From the company's perspective, its strengths lay in its 'unique breadth and combination of skills which acts as a catalyst for the economic growth of industry'. Supporting this claim was the 63% growth in revenue generated from the private sector in the ten years since the company's establishment.

[26] Field Crop Products CRI, DSIR Establishment Unit, Newsletter, 19 Feb, 1992.

Consistent with the expectations placed on the CRIs by Government, Crop & Food Research had placed emphasis on value creation through the development of intellectual property, and on commercialisation of technology in collaboration with industry partners. As a result, the company had generated 12 new pieces of commercialiseable intellectual property between 1997 and 2002, leading to sales, research development agreements, and four commercialisation joint ventures. Further, shareholder value had increased by approximately 90% during the period 1992-2002, enabling $3 million to be reinvested into the company's own venture investment fund. From CEO Paul Tocker's perspective

> "Improving the performance of the Institute is based on integrating clearly focused scientific research with a route to market through industry partnerships".

Building on these successes, the Crop & Food Research's forward strategy was to build on this base by increasing the emphasis on the generation and commercialisation of intellectual property with industry partners. Considerable effort was also been placed on updating and refining the company's strategy and capability looking out ten years from 2001, which was reflected in a subtle change in the company's mission. Where previously the focus had been on producing 'excellent science', the new mission became one of 'creating knowledge and value from scientific discovery'. Alongside this, a new strategy was developed, comprising four cornerstones, each designed to promote economic growth, and to apply and sustain technical skills and knowledge. The new strategy is represented in Figure 4-8.

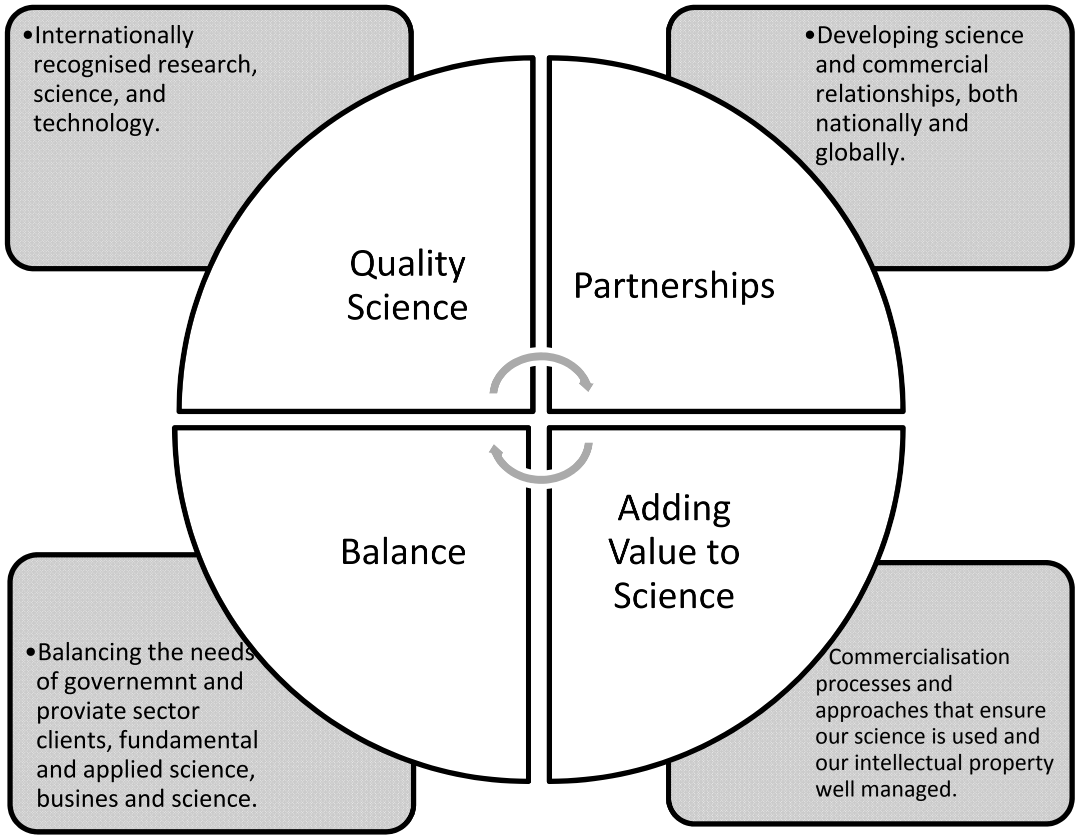

Figure 4-8: Cornerstones of Business for the Crop and Food Institute circa 2004

Technology innovation

To stimulate activity in discovery and innovation, and to meet the forward looking strategic objectives, the company instituted a policy to fund 'bright ideas leading to registrable and non-registrable intellectual property', including research and business innovation. The aim of the aptly titled 'Eureka Fund' was to stimulate and reinforce a culture of discovery and innovation, from research and support staff, from bright ideas through to ‘seed funding’. Each month $10,000 was to be made available for the best idea based on developed criteria and guidelines (refer Figures 4-9 and 4-10). Applications to the Eureka Fund were closed off on the last working day of each month, and forwarded to a review panel comprising of the GM Strategy and Policy, GM Research, GM Market Development, and 2 science team leaders. The panel scored each ‘idea’ using a check sheet on aspects of:

- Innovation capacity
- Potential intellectual property (products, platforms spin-offs)
- Value to Crop & Food Research
- Route to market
- Concept quality

In order that standards were maintained, the panel reserved the right not to fund any idea in a particular month, to hold over good ideas for another month, or to divert ideas into other funding options. In all cases the decision of the panel was to be final, and summarised decisions would be given to all applicants. Once an idea was selected for Eureka Funding, the project initiator prepared a detailed project plan in accordance with a standard template and attaching a project timeline. The project plan detailed key milestones and deliverables, and was reported to the review panel within 6 months.

For Crop & Food Research, the key performance indicator for science discovery is the number of referred science papers and publications. An associated performance indicator for innovation arising from science discovery is registrable and non-registrable intellectual property from research concepts, and Eureka Fund ideas had become a new performance indicator for the company's innovation ability.

Figure 4-9: Application Sheet for the Eureka Fund

EUREKA FUND

CREATE A CONCEPT

Project initiator:	**Project title:**

Description: (Two sentences)

Date submitted:

What's the opportunity?

How are you going to do this project?

What if the benefit to CFR:

Results of patent search?

Committee completion

Date considered:

Feedback:

IN CONFIDENCE

Figure 4-10: Eureka Evaluation Check List

Application number: **Evaluation panel member:**					
Numeric Scale	**5**	**4**	**3**	**2**	**1**
Innovation	Very Strong	Strong	Average	Below Average	Weak
How would you rate the technical 'wow'					
Research Approach	Very Strong	Strong	Average	Below Average	Weak
How would you rate the proposed method?					
Opportunity Size	Very Strong	Strong	Average	Below Average	Weak
How would you rate the size of the opportunity?					
Benefit to CFR	Very Strong	Strong	Average	Below Average	Weak
How would you rate the likely returns to CFR?					
What other factors were considered?					
Recommendation	Fund	Forward to next round	Resubmit with reasons	Decline with reasons	
Date decision notified:					

Six months after its establishment, a preliminary analysis of the Eureka fund was carried out by the GM Research. In its first 6 month period, the Eureka Fund had received 24 applications, of those 7 applications were funded, which equated to 58% of the target KPI of 12 per annum. Within 12 months, the panel had vetted 26 applications, of which a total of 9 (35%) had been granted Eureka Funding.

Notably, in an attempt to increase applications to the budgeted 60 applications, the panel modified the 'hurdle' rate for the innovation score, reducing it to 3.5 (average+), and began to encourage science and support Team Leaders to apply by establishing Eureka Fund applications as a KPI for the various teams. Interestingly, it was the science teams that took responsibility for evaluating the 'opportunity size', but they often struggled to generate the necessary market and potential customer information required to push their innovation concept through to funding. As a consequence, teams lost confidence and/or interest in pushing their ideas further, and many innovation concepts fell by the wayside. Effectively, lack of marketing knowledge, rather than technical innovation potential, was responsible for innovation failure and lost technology product opportunity.

Technology transfer

The company's approach to technology development and transfer centers on identifying and working with industry partners to discover new knowledge and new markets. The company's website directs enquiry toward the science team leaders and business managers who 'can help you find the scientists you need, or assemble a project team to work with you'. The emphasis is on strong working relationships, with recognition that 'the client' places a high value on having one-to-one relationships with an expert in the field. The company also recognises that significant advances in research often happens when scientists from different disciplines work together, and the Crop & Food Research 'takes pride in an ability to put together multi-disciplinary teams that are able to focus on different points along the food value chain'. To this end, a lead scientist proclaimed that:

> "Our scientists enjoy working directly with clients and are very good at it".

Like their science counterparts, the business managers are also encouraged to work with clients, although their focus is less on developing 'relationships', but rather is concerned with ensuring that all parties understand and accept the contractual framework for any research project. Indeed the role of the business manager was to 'develop and manage contracts, memoranda of understanding, and intellectual property agreements'. It was not to do with, for example, collaborative relationship development, technology value proposition development, or promoting company technological knowledge into new applications or markets. In fact, often it was the scientists who had the more direct relationship with the customer, albeit of a technical nature. Moreover, while business managers were 'assigned' to science teams, their activities were functionally separate, meaning that the scientists did the science and the business managers managed the intellectual property and the contracts. This lack of cross functionality is reflected in the comments of a senior manager, who suggested that

> "Now often and with any structure you have the danger of silos where people operate only when they're in their own environment, talk to their own people and we're missing out on what I would say is a rich opportunity around cross capability, cross fertilisation across our teams in bringing things together".

As part of delivering on the key objective of creating value by commercialising science, the company developed a 'decade out' view in which it aimed to significantly increase the value created for its partners by commercialising its science and technology. The strategy involved stimulating the development of intellectual property in the science teams and then creating value from that intellectual property through appropriate commercialisation.

However, the company's Strategic Plan 2004-2008 identified a number of issues concerning its approach to technology transfer, and in particular, many of the identified issues, shown in Table 4-4, making specific reference to what could be considered as 'marketing aspects'.

Aspect	Issue
Growth:	• Lack of market presence • Need to improve science and commercial resource alignment • Need to develop routes to market • Need to improve market intelligence
Partnerships:	• C&F – University relationships poor • Difficulty in attracting private sector partners for leveraged investments and key accounts
People:	• Need to strengthen team of commercial project managers • Resolving tension between science as knowledge and science for commerce
Discovery:	• Stimulating a culture of innovation • Building strength, leadership and market connections in science focus areas • Developing strong science alliances

Table 4-4: Market-related Issues identified in the 2004-2008 Strategic Plan (Source: Crop & Food Research)

If there was a need for more direct engagement with the market, and in particular with connecting the company's science and innovation potential to specific requirements of end-use there were some technology transfer challenges ahead for Crop & Food Research. For example, what marketing resources would be needed to identify the ‘size of the opportunity’ for Eureka Fund’ innovation ideas; how could intellectual property be valued without reference to market intelligence; how would the best route to market for innovation concepts and technology potentials be determined.

Despite these concerns however, Crop and Food Research had identified that collaborative relationships and the joint development of technological knowledge would best position the firm for technology transfer. The new strategy for technology transfer is represented in Figure 4-11.

Figure 4-11: Crop & Food Research Technology Transfer Model circa 2005
(Source: Adapted from Crop & Food Research Annual Reports, 2001-2005)

4.8 HortResearch Ltd.

HortResearch came into being on 1 July 1992. Initially called the Horticulture and Food Research Institute of New Zealand Ltd., it was the first time that New Zealand's diverse horticulture industry could call on a dedicated research organisation to assist with science and R&D. As with the other CRIs, it had its beginnings in Government science departments and research stations, and as a result, began life with more than 500 staff and a network of 10 research orchards.

From the outset, HortResearch targeted the strengthening of its links with the horticulture sector, and in addition to beginning with substantially more research contracts than was expected, it quickly turned its technical expertise towards developing technologies for the industry. For example, in its first year of operation it laid claim to boosting New Zealand's export earnings with the joint development of the 'Tipit Gel Pruner', described as 'a gadget for use in kiwifruit orchards', and a new technique for rapidly detecting the devastating leafroll virus in vineyards. This early reliance on collaborative work was reflected in the company's first annual report (1992)

> "Working separately no-one can effectively tackle the issues, but by working together we are starting to see major breakthroughs. People from the industry are constantly telling us that our research is focused and exciting. They have realised that we can definitely boost the growth of their industry and are keen to work with us because they know that an effective industry partnership will help us maintain New Zealand horticulture's position as a world leader" (Roger O Davies, Chairman)

To ensure that science and technical expertise reached the sector, the company put considerable effort into building up its networks, working as part of, rather than alongside the industry. Its networks were made up of representatives from all levels of the horticulture industry, and allowed the company to develop a strategic ‘knowledge and information system’ based on the feedback from ‘Link Teams’ whose members included scientists, technologists, and business specialists. For HortResearch, ‘cross-functionality’ though the Link Teams together with staff ‘technology transfer training sessions’ ensured an effective flow of information between growers, marketers and scientists.

Profitability, too, was an early and key element of HortResearch’s business philosophy, and in addition to ‘bringing stability and scientific growth to the company’, the commercialisation of technology was seen as providing the means to ‘rebuild and reposition’ the organisation after a long period of being run down by the previous government department regime. Indeed, in many respects HortResearch had made the transition from ‘Government Department’ to a commercial company that was capable of delivering excellence in science and technology, and one that was ‘able to offer clients normal terms of business’.

By 1996, the company had cemented its strategic direction and considered itself to be well placed to 'develop and enhance the horticulture, plant, tree and food industries through excellence in science and technology'. The knowledge and information transfer strategy launched in 1992/93 was promoting the company's core competencies, new client relationships emphasising two-way communication continued to be established, and Link Teams were proving an effective mechanism for co-operative industry problem solving. As shown in Figure 4-12, HortResearch was demonstrating that it was possible to sell science and information to industry.

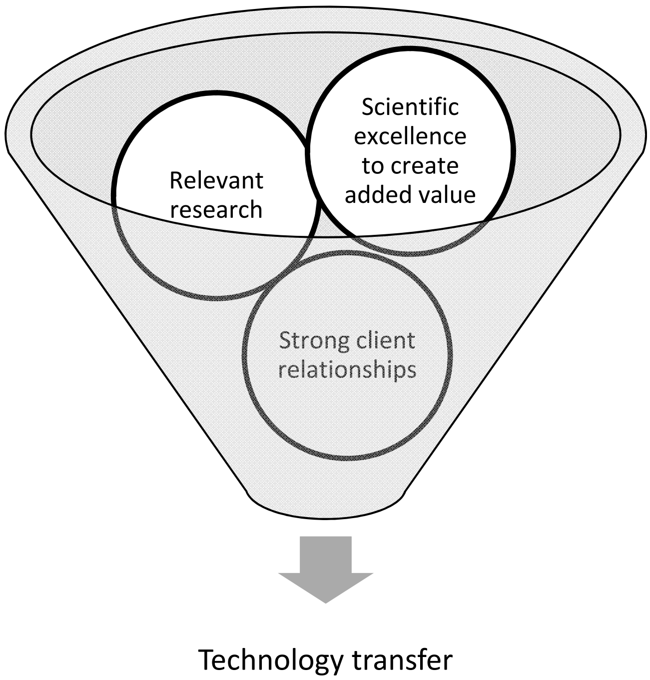

Figure 4-12: Features of HortResearch Technology Transfer Strategy, circa 1995

By 1997 however, things began to unravel. The company failed to increase its funding from the PGSF on the back of a perception that there was limited growth potential in the horticulture industry, likely driven by a marked decline in the fortunes of kiwifruit, and an apparent belief by Government that investment on horticulture was 'already high'. Additionally, the Government's "user pays" system began to have a marked effect on the company's consulting activities, and because income from commercially applied science was down, the company's financial performance 'fell below expectation'.

The unsatisfactory financial result prompted the Institute's Board to make it very clear to senior management the requirement to meet the financial expectations necessary to maintain HortResearch's viability as a business, and the Annual Report duly reported that:

> "Following the disappointing financial performance this year the lessons of a commercial approach to investment in research and development will be heeded appropriately" (Roger O Davies, 1997, p.3).

Clearly, an approach to technology transfer that was reliant on 'good applied science' and 'good relationships' was not enough, at least not in an increasingly competitive economy that by 1997 was beginning to show signs of valuing 'knowledge' rather than 'scientific research and information' as the means to competitive advantage.

The company's response was to develop and pursue new commercial opportunities in order to lessen the dependence on funding from Crown contracts and mitigate exposure to reduced support for research in the primary production sectors. The intention was to develop a greater degree of self reliance through a robust business plan which would restore the confidence of its scientists and others involved in the future of the Institute. But a new business plan by itself was not going to be enough for the company to position itself as a 'world leading science institution'. The newly appointed CEO understood this, and in 2002 the company embarked on a strategy development process that included a complete restructuring and refocussing of all science and commercial activities. It also included a review of the 'market spaces, technology trends and external environment likely to be faced by the organisation over the next 10 years'.

The strategic review process allowed the company to reconsider its science portfolios from the perspective of new collaborations and different market perspectives. By 2004, all of the science portfolios were ranked according to 'strict commercial criteria', and new 'profitable' market spaces were identified where HortResearch could become a global leader.

Technology innovation

Once the strategic direction had been established and 'growth areas' identified, a complete review of science was carried out to test its fit with the new strategic pathway. Sixty science programmes were reduced to twenty-one, and each was focussed on three research areas: food and health; sustainable production; and biotechnologies. The expectation was that increased opportunities for cross-linking and integration between the newly focused science groups would promote and accelerate innovation ability and technology transfer, although for Chief Scientist DR Ian Ferguson, "science is firmly in the driving seat" (Annual Report, 2004, p.15).

The company also planned to build an innovation culture where 'blue sky' thinking became a catalyst for innovative science and technology development, and to facilitate this, the company launched its "Big Ideas" innovation system. The intent was to capture, assess and channel 'Big Ideas' into appropriate science and business areas where they could be resourced and advanced. To achieve this, the company began implementing various 'activities and processes' designed to promote innovative behaviour, including cross-functional work groups, a flexible rewards policy, and travel opportunities for those who published in acclaimed international journals.

For Board Chairman Anthony Briscoe, 'filling the growth pipeline through a focus on market-aligned 'Big Ideas' within science programmes is an approach that will increase the speed and quality of intellectual property delivery'. Clearly, the expectation was that by improving the company's innovative ability, the steady increases in revenue shown in Figure 4-13, could be anticipated from the commercialisation of intellectual property.

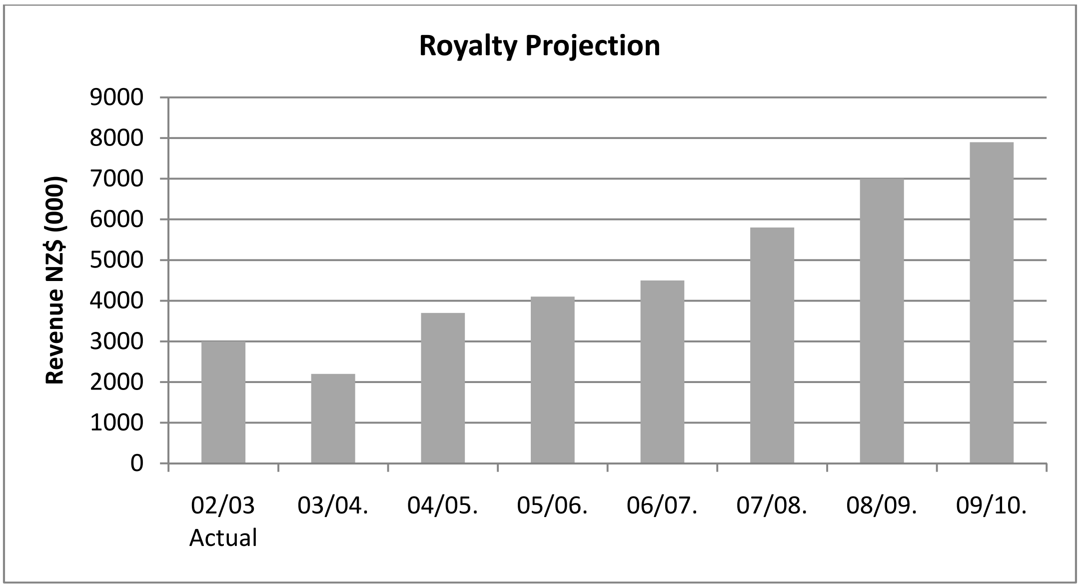

Figure 4-13: HortResearch Intellectual Property Revenue Projections, 2003 (Source: HortResearch)

Technology transfer

By 2004, the company had 21 science programmes that were equipped with commercialisation goals in terms of intellectual property targets and paths to market, and business development teams were promoting the science / market interface. For the executive team, the alignment of science and business imperatives together with the new innovation processes would transform the company's science outputs into 'wealth creating' potentials. The company now had a model for technology transfer (Figure 4-14), and commercial partnerships would focus science effort toward saleable intellectual property.

However, wealth creation requires the capture of ideas as intellectual assets and the transformation of those assets into commercial reality. Modern research and development is characterised by tension between the push of innovation and science development and the pull of customers and commercial markets, and achieving a balance between these forces would be crucial to success. While it was true that the company could count on fee for service and PGSF funding for revenue generation, in the longer term it was technology development and transfer that offered the best prospect for sustainable commercial success. But by 2006, some four years after the new strategic initiative, 60% of the company's revenue was still coming from government funded grants, and if it was to reduce that to the targeted 40%, then the amount of commercialisable technology emanating from the company needed to be substantially increased. After all, it was one thing to align science effort and plan for intellectual property licensing or outright sale, but it was another to develop the innovative ability, technological knowledge and internal processes to take the innovation through to market readiness. Furthermore, the assumption that technology developments would be 'what the market wants' are predicated on detailed knowledge of the problem that the technology is solving, or the opportunity that it is providing, both of which require a level of relationship and market intelligence. As was noted by the company "some of the business and research spaces we have entered are in their infancy, their boundaries ill-defined, and in these areas HortResearch is helping to build the space" (Annual Report, 2005, p. 24).

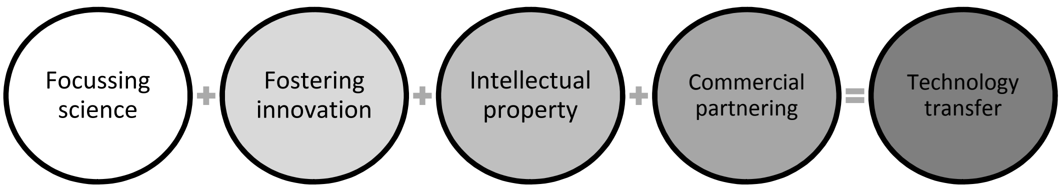

Figure 4-14: HortResearch Technology Transfer Model circa 2005
(Source: Adapted from HortResearch Annual Reports, 2001-2005)

4.9 Industrial Research Ltd.

From its establishment as a CRI in 1992, Industrial Research Limited had an intention to be acknowledged as a leading force underpinning the success of New Zealand industry. This vision was encapsulated in the 1993 Statement of Corporate Intent:

> "To conduct viable world class scientific research that leads New Zealanders to internationally competitive added-value opportunities"

As part of this mission, and in accordance with the purposes and principles of the CRI Act, Industrial Research intended to 'conduct research and introduce new technologies leading to new products, processes and services in partnership with industry, leading to technology transfer'. This clarity of vision from the new CRI was further reflected in their principal objectives, which were to 'undertake world class scientific research for the benefit of New Zealand, 'develop on-going key client partnerships', and to 'substantially increase commercial funding'.

To achieve these objectives, the company identified six key research areas, with scientifically complimentary teams in:

1. Natural product processing
2. Materials science and performance
3. Production automation and control

4. Communications, electronics, sensing and information technology
5. Measurement, applied mathematics and analysis
6. Packaging, storage and transport.

The diverse range of research activities demonstrated that the company was able to offer a full range of industrial research activities from theoretical to applied, although they were weighted towards the ‘strategic and applied end of the spectrum’. The research itself was conducted in the physical and biological arenas using physics, chemistry, information technology and engineering sciences, and was carried out under contracts gained in the competitive public and private funding environment.

From the outset, the company’s business focus was to exploit research, information and technical knowhow, and it set about developing new processes and products and exploring commercial opportunities that could bring competitive advantage to itself and to its customers. The company set itself apart from the other CRIs in that, after only one year of operation, it began setting up performance measures, identified in Table 4-5, which included operational targets for technology transfer:

1993/94	
1.	Conclude at least 550 commercial reports to clients
2.	Increase commercial revenue to $1.1M for the 1993/94 financial year
3.	Reach at least 15 agreements, transferring or registering intellectual property each year
4.	The acceptance of at least 3 Technology for Business growth contracts
5.	Increase client commercial numbers to 70, being clients with whom $50,000 or more of research is undertaken annually
1994/95	
1.	Undertake at least 20 contracts with NZ companies of value greater than $100,000
2.	Have at least five new TBG contracts with NZ companies accepted in the 1994/95 year
3.	Prepare at least 100 substantive commercial reports for NZ clients
4.	Publish at least 10 articles describing research activities in NZ trade journals
5.	Send a quarterly information document to over 2,000 individuals and organisations in NZ describing the application of research results

Table 4-5: Industrial Research Technology Transfer Targets, 1993-1995
(Source: IRL)

By 1996, Industrial Research saw itself as a commercially focused scientific research and technology company. Reinforcing this belief was the ease in which it adapted its science and business philosophy to match the needs of the industrial and commercial sectors in which it operated. For example, it demonstrated its responsiveness by reducing the number of science divisions from six to four, adding the energy sector to the processing and manufacturing sectors; and to cater for the expected growth of 'high-technology start-ups', it created a new science/technology incubator group. The company's new vision now matched the developing technological needs of its customers and the expectations of its government stakeholders:

> "The creation of wealth through science and technology".

Technology innovation

In many respects, Industrial Research's business had undergone something of a transition. Where in the past it had focused on the application of scientific research, its core business now concerned the development of technological knowledge and intellectual property, and the transfer of technology. As a consequence, the changes in scientific and R&D focus created the conditions suited to the development and transfer of technology, and by meeting the technological needs of its customers, it began to realise revenue streams through the sale or licensing of Intellectual property, and through spin-off companies.

For the company, the scientific and technological intellectual output from its 320 science staff was now seen as the "bedrock on which the business is built", and management of the company's intellectual property portfolio became a key business activity, with resources directed to 'where returns can be readily realised'. The development of intellectual property also created the opportunity for business partnerships and joint ventures, and by 2002 Industrial research had spun-out ten subsidiary companies based around proprietary technologies. It also laid claim to the intellectual property surrounding the material required for super high-temperature conductivity, the company's scientists having discovered the ceramic compound in 1988, going on to develop the process for turning it into a flexible, current-carrying core that could be kilometres in length. In this technology alone, the company now had a world leading position in a market predicted to be worth US$240 billion over 20 years. Figure 4-15 provides a graphical overview of the firm's Innovation process.

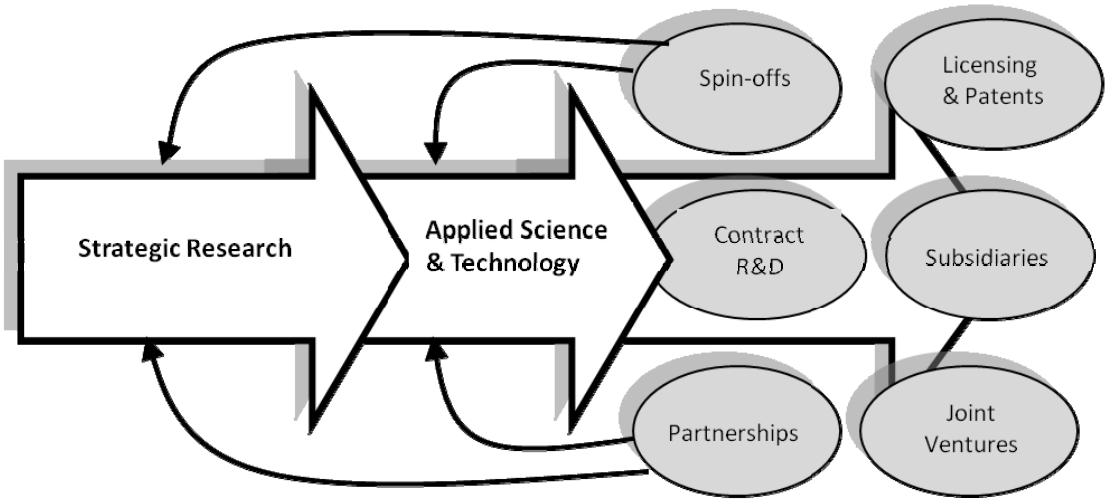

Figure 4-15: Industrial Research Innovation Process, circa 2001 (Source: IRL)

Technology transfer

But the super-conductor technology was but one success, and given the levels of investment going into the company, its stakeholders now had a thirst for more.

This hastened the arrival of a new CEO in 2002 who brought a new set of eyes to the business and to its technology transfer capabilities. The new CEO had noted that while the company's revenues were 'less funded and more earned', the organisation needed to redouble its efforts to 'convert ideas not only into practice, but into commercial viability'. For the CEO, it was one thing to have enormous value in intellectual property and significant knowledge assets, but the challenge would be actually realising it in financial terms, and;

> "For an organisation with such assets its financial performance has been moderate, but not spectacular" (Nigel Kirkpatrick, 2002).

It quickly became apparent that a new aspect to the company's technology transfer activities was being pushed. Certainly the importance of developing applied technological knowledge and intellectual assets would remain, but a new perspective was being brought to bear on the company's innovation and technology transfer effort – and that was the perspective of the customer. For the CEO, any success that the company had enjoyed to date resulted from the 'business of science and technology backed by service', and it was service provision and the development of more effective commercial partnerships that would receive close attention. The new business approach was to focus on:

1. Building long-term partnerships

2. Adding value to industry
3. Developing open, trust-based relationships with clients and partners
4. Working closely with clients to develop a full understanding of their needs and opportunities.

During the last decade, Industrial Research had carefully and patiently built a bank of knowledge and expertise through contract research and development for both public and private sector clients. The company now had an enormous asset from which even greater value could be derived for Industrial Research and its clients. The next step required a shift in emphasis, and involved taking some of the company's science assets and technological knowledge, and taking them to market, not just in a consultancy sense, but by creating new applications in new industries with new clients, or by marketing the intellectual property or establishing new spin-off businesses.

As shown in Figure 4-16, the company now had two opportunities to derive value: science *and* commercial practice. And like its science counterpart, commercialisation too was now seen as a process and a discipline. Science was now seen as starting in the laboratory with an idea, and marketing was seen as starting in the market with a customer need. The key question for Industrial Research was whether it could meld the two, because arguably, unless both functions can collaborate, the chances of the company being successful in technology transfer are not great. Furthermore, deriving value requires an innovative vision for the value of the technology and this requires market intelligence and resources. It also requires commercial partners. Clearly there were some marketing challenges ahead for the company.

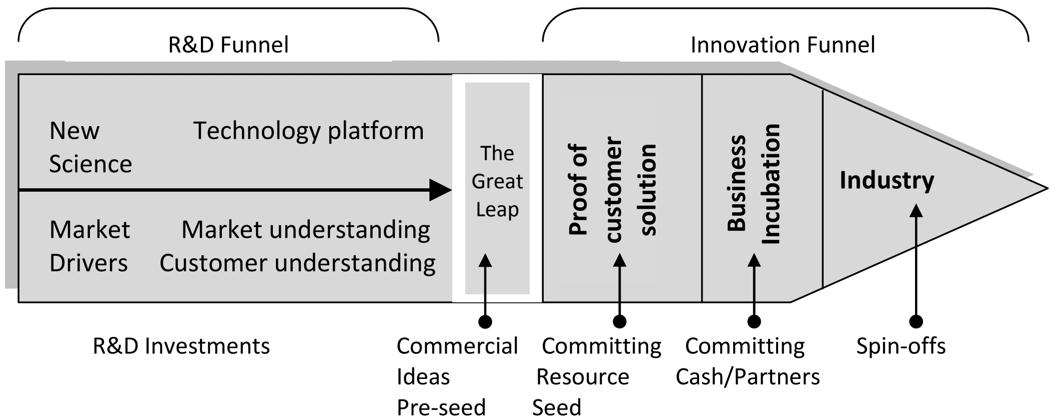

Figure 4-16: Industrial Research Business Model, circa 2004
(Source: IRL)

Chapter 5 - WITHIN-CASE ANALYSIS AND FINDINGS

'The business has two – and only these two – basic functions: marketing and innovation. Marketing and innovation produce results; the rest are costs' (Peter Drucker)

Introduction

Chapter Five presents an analysis of marketing's role in technology transfer from the perspective of each firm, using the study's conceptual framework (Figure 2.9) for context. The analysis began with the coding and interpretation of documents and reports[27], with a particular focus on firm strategy concerning innovation and technology transfer, as articulated by the executive team and Board. This was important because, while the study sought to understand and interpret the phenomena associated with the interviewees direct experience, thematic analysis of company documents provided an opportunity to compare the more objective document themes with the interview data and the actor's direct experience. To this end thematic analysis of *Case* firm documentation illuminated a series of perspectives that were considered by each firm to be important for technology transfer success. These firm level perspectives are represented as 'cogs' in the technology transfer process, and for each *Case* firm,

[27] Case documentation sources included annual reports, business plans, historical accounts and biographies, press releases, and web site information.

are presented before the analysis of individual ‘actor’ perspectives of technology transfer.

This comparison of the ‘firm’ perspective of technology transfer with that of the ‘actors’ is consistent with the study’s intent to illuminate a more holistic view of marketing that at once provides for the individual and firm perspectives, while taking account of literature themes and the author’s reflexive position. In this way, the study hoped to provide a practical guide for industrial marketers and firms.

Where document analysis illuminated technology transfer themes at the firm level, researcher ‘immersion’ in the *Case* occurred through participative observation of informal technology ‘planning’ meetings, and through the collection of raw data from twenty one semi-structured interviews (refer Table 5-1). The interviews were conducted with a mix of science (technical) and marketing (commercial) staff from each firm, each interview having an average duration of 90 minutes. Where subsequent clarification of the transcribed interview data was needed, respondents were followed up with an informal discussion, often by phone, allowing the researcher to clarify and expand on the phenomena and concepts that had emerged. As stated above, this raw data was further analysed against the documentary evidence and the developed literature themes.

	Interviewee	Function	Interview Duration (Hours)	Transcribed Pages (at 1.5 lines)
Case A	1	Scientist	1.25	15
	2	Scientist	1.25	12
	3	Scientist	1.50	16
	4	Scientist	1.50	16
	5	Marketer	1.25	13
	6	Scientist	1.50	17
Case B	1	Scientist	1.50	16
	2	Marketer	1.75	20
	3	Scientist	1.25	15
	4	Scientist	1.50	16
	5	Marketer	1.75	19
	6	Scientist	1.75	20
Case C	1	Scientist	1.75	21
	2	Scientist	2.00	23
	3	Scientist	1.50	15
	4	Marketer	1.50	15
	5	Scientist	1.75	21
	6	Marketer	1.25	15
Case D	1	Marketer	2.15	28
	2	Marketer	1.75	20
	3	Scientist	1.25	13

Table 5-1: Overview of Interviews

Throughout the analysis, the researcher’s understanding of the *nature* of the preconceived ‘stages’ of the conceptual framework were frequently tested and modified by the phenomena occurring within each firm. Nevertheless, the fundamental concepts making up the conceptual framework, and their broad relationships, were sustained through this process, lending support to prior research on which the model was based. Furthermore, the empirical data, when hermeneutically interpreted with the discovered literature themes, generated new understanding of marketing's theoretical role in the technology transfer process.

The within *Case* analysis for each firm is presented below. For reasons of participant confidentiality, each firm is referred to as *Case* 'A', 'B', 'C', or 'D'. Business unit 'names' and job 'titles' have also been obscured.

5.1 Within-Case Analysis Strategy

While Chapters Five and Six are designated as analysis chapters in this study, Chapter Four's description of the *CRI case* facilitated the amalgamation of notes and observations taken from the field, *Case* documentation and interview transcripts from technical and commercial participants. This allowed the researcher to begin comparative analysis of *the 'field data'* with the *technology management and marketing themes* developed during Chapter Two. This initial 'play with the data' (Yin, 1994) served three strategic purposes.

First, it allowed the researcher to begin a phase of data immersion and reduction utilising the conceptual framework of technology transfer developed in Chapter Two to focus the analytic strategy. The objective was to explore and analyse the data against the constructs of technology innovation, development, transfer and diffusion within and across the *Case*, and concomitantly, illuminate the marketing activities and processes associated with technology transfer effort.

Second, it began the process of open, axial, and pattern coding of the interview data as described in Chapter Three, permitting the researcher to compare and contrast the empirical 'evidence' from each firm with the developed literature themes, thereby 'promoting analysis through differentiation and combination of the data' (Miles et al., 1994, p. 56). Third, it ensured 'replication logic' (Yin, 1994) across the *Case* by reflexively comparing and contrasting themes in marketing practice with the phenomena that emerged from the raw data. Because the analysis strategy focuses on the various roles that marketing plays in firm technology transfer, Chapter Five uses the conceptual framework of technology transfer developed in Chapter Two (Figure 2-9) to analyse the technology transfer effort of each firm. Here, empirical data associated with each stage of the model is coded using 'open' and 'axial' techniques, with the emergent concepts compared with the themes and concepts developed from the literature. The study's phenomenological leaning sought understanding through the actors direct experience, and by drawing on theory to illuminate *Case* phenomena, roles for marketing could be theorised by evolving the phenomena into concepts, the concepts into categories, and the categories into theoretical roles. This process is represented in Figure 5-1, below.

Chapter Six expands the analysis by utilising the technique of pattern matching to search for themes and concepts occurring *across* the research setting. In this mode of analysis, empirical patterns are compared with the theorised concepts and categories, and with literature themes in order to test for literal replication. This identification of phenomenological patterns, particularly when compared with marketing theory, will strengthen the case for the analytical generalisation *and* reliability of the study (Miles and Huberman, 1994; Yin, 1994). Moreover, the opportunity for the author to reflexively triangulate the raw data with observed phenomena, and with firm documentation, assisted in identifying concepts and categories in firm technology transfer effort *that were occurring in a 'new economy' environment*. This allowed the analysis to consider whether marketing's traditional '4Ps' were reflected in the research setting, and indeed, in the actor's *perception* of the 'marketing' function.

Triangulation of the data tests the proposition that the 'new economy' presents a new 'marketing environment'[28], and further that the phenomena associated with firm technology transfer effort reflected a role for marketing that placed emphasis on technological 'knowledge', internal and external 'relationships', and inter and intra-organisational 'collaborative activity'. In this regard, a conceptual framework for marketing's role in firm technology transfer is presented in Chapter Seven.

[28] Refer Figure 2-3, Chapter Two.

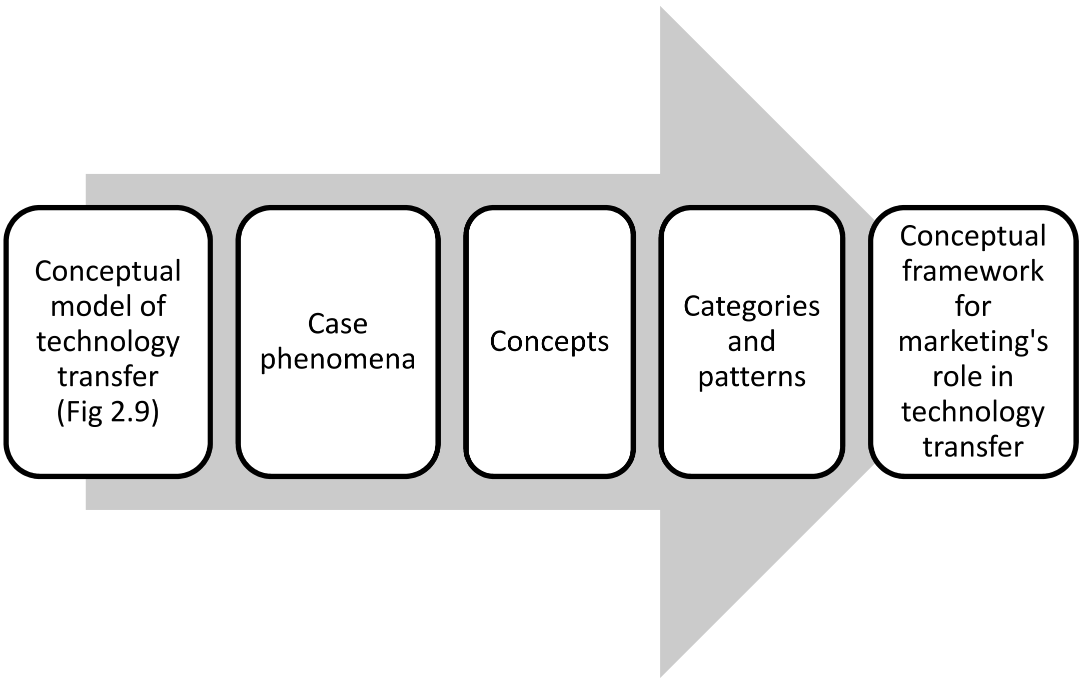

Figure 5-1: Technology Transfer: conceptualising marketing's role

5.2 Case A:

5.21 The Firm Perspective

First observations revealed that, while the campus comprised several acres of park like grounds with a front office staff that were helpful and pleasant, there was however no immediate sense that this was a highly credentialed science institution with significant industrial technology transfer capability.

As is common practice, visitors, associates, clients, and prospective customers reported to reception in the main administration building, which was of interest because this was the 'image' the firm presented to its market. It was observed that the reception area did not display information about the firm or its technology products and services[29], and apart from some ‘agricultural magazines’, it presented a somewhat ‘institutional’ face to the world. It was concluded therefore that the image presented by *Case A* was more akin to that of a classical ‘scientific institution’, as opposed to one that portrayed an image of innovation and technological potential.

However, while the firm’s technological potential was not necessarily reflected in its physical appearance, it was clear that the board and executive team had recognised that fostering innovation and developing technology transfer capabilities was critical to the firm’s success. Accordingly, an overarching strategy to promote technological potential had been developed. The strategy comprised of ‘ideas’, and firm documents describe how these ‘ideas’ would:

> “...together with end-users, investors, and collaborators, create a more valuable future for New Zealand through science and technology”.

That the firm’s strategy now reflected an express intent to develop and transfer technology, as opposed to ‘doing science’, was reflected in comments made by the General Manager Commercial, who stated that:

> “The organisation is focused on the discovery, development and commercialisation of new and leading-edge technologies for the

[29] It is acknowledged that there was, separately, an information kiosk on the campus.

> benefit of New Zealand. We pride ourselves on our ability to provide innovative solutions to industry problems and for generating a return for our science via its commercialisation.”

Importantly, the focus on technology transfer brought with it a realisation that things ‘needed to be done differently, and that maintaining the status quo with technical and commercial work practices would not guarantee technology transfer success. As was highlighted in Chapter Four, merely having *the intent* to establish new trading entities with external partners, or working with third parties to get technologies to market, or conducting joint development projects with external customers, did not in itself guarantee the transfer of technology. The firm was now recognising that for transfer to happen, new ‘activities and practices’ would be needed in order to promote and nurture the firm’s innovation and transfer capabilities. This developing *sea change* in the firm’s attitude toward managing technology is reflected in comments by the General Manager Science, who stated that achieving success in technology transfer:

> “...will require new practices, approaches and technologies generated through an understanding of how systems work, as well as the integration of appropriate new knowledge and technologies at all levels.”

If achieving success in technology transfer brought with it identification of the need for new approaches to managing the firm’s technical and commercial effort, then the development of ‘relationships’ and ‘collaborative activity’ were seen as the means by which this could be achieved. For C*ase A*, relationships and collaborative activity had become central resources in its technology transfer effort, with their importance reflected in reported comments from the Board Chairman:

> “*Case A* is making a major effort to engage with others across the sector, to look for areas of common interest, investment and cooperation where results can be accelerated by pooling resources and IP.”

As discussed in the preceding chapter, the link between science and commercialisation in *Case A* occurred through the *Commercial Group*, and the executive team and Board had determined that ‘all business activity was to be managed by this group’. Thus from the firm’s perspective, the transfer of technology from science to market was to occur through this group.

However, in seeking to adopt a more ‘collaborative approach’, *Case A* had recognised that functional separation of the technical and commercial teams would no longer serve the firm’s focus on the development and transfer of technology, and “new practices, and approaches” were required to engage with the new business environment.

To address this, the *Commercial Group* had been newly structured around a number of commercial teams, with each team focussed on a specific science group. Company documentation describes how the mandate for each team was to:

1. Work closely with science to generate revenue flow from commercial contract R&D
2. Generate financial return from the science undertaken in their science group via intellectual property licensing, the sale of research outcomes or partnerships with other organisations and businesses
3. Manage customer relationships, intellectual property, an investment fund, and mergers, acquisitions and divestments.

By creating a structure so that ‘marketing’ could interface with ‘science‘, *Case A* had recognised that as both functions increased the level of collaboration, innovation activity would become more ‘market-based’ and the chances for technology innovation and transfer were improved. Thus, in recognising the need for greater levels of technical and commercial cooperation, *Case A* had identified that marketing knowledge and technical knowledge were resources that could be exchanged, thereby increasing the alignment of the firm’s technical capabilities with the ‘wants and needs’ of its target market(s). In this way, cross-functional knowledge sharing and cooperation, when applied to resolving the technical and commercial challenges facing the firm’s customers, would focus technology transfer effort on providing competitive solutions to specific customer and network ‘problems’. As the General Manager Science suggested, this exchange of technical and market knowledge could:

> “...generate knowledge intensive value chains that meet evolving changes in market demand.... and create value added products with high quality and assurance.”

For *Case A,* the strategy to improve the rate of technology transfer had, inductively, shifted in emphasis. Where previously the focus had been on ‘doing significant science’, the intent was now more focussed on cross-functional collaborative effort and the exchange of technical and market knowledge. If this could be achieved, then innovation effort would be directed by the requirements of the market, and expanding network relationships would provide further opportunities to develop and transfer technology and technological knowledge. This change in the firm’s emphasis is illustrated in Figure 5-2.

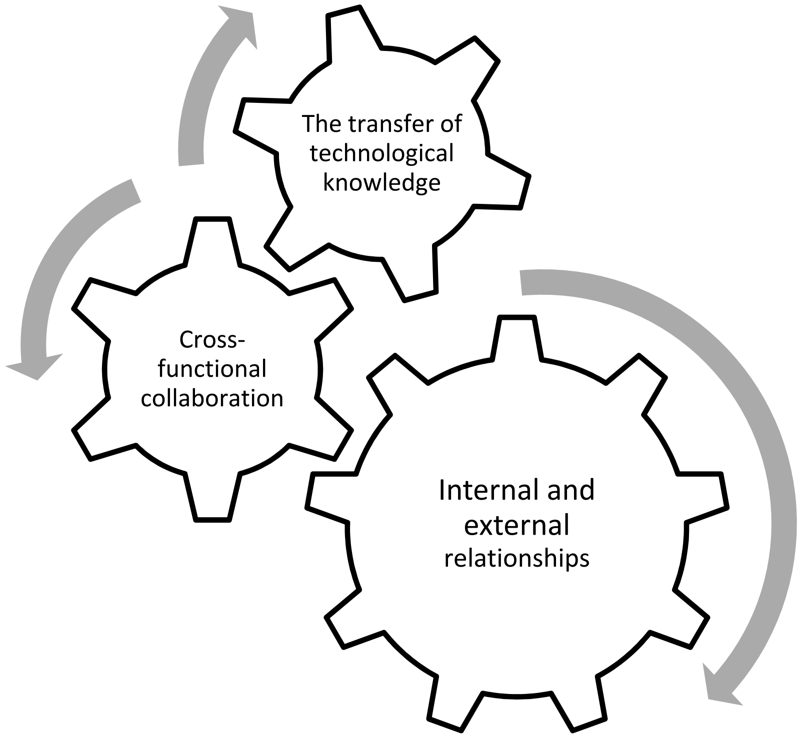

Figure 5-2: Case A Technology Transfer: the firm perspective

5.22 The Actor's Perspective

While the Board and executive team were focussing on developing 'relationships' and promoting 'collaborative activity' to enhance the firm's technology transfer effort, analysis of the raw data sought to reveal whether these 'concepts' were reflected in the *actor's experience*, and indeed, whether marketing played a role in this effort.

5.22.1 Technology Innovation

For *Case* A, innovation activity was spread across a number of targeted science arenas, each encapsulating a mix of fundamental and applied science. What was of interest to the study concerned the interviewees perspective of innovation – what was *their* attitude and approach to technological innovation; how was innovation potential being identified and realised, and what role was marketing playing (or could play) in innovation effort?

Analysis of the interview data showed that the respondents' attitude and approach to innovation was variable. For example, one interviewee stated:

> "Well probably I've not been the sort of person who has had an organized system for responding to ideas and I am not saying that it's good that I haven't…but I suppose it comes down to when something starts with you and you think and it fires your imagination and you think yes I'd like to have a go at that and be part of that."

In contrast, another interviewee stated:

> "The group that I manage is very much about looking into [*Case A*] and seeing what might come out of the test tube or out of the laboratory and where does that concept...where does that idea fit within an industry system."

Another interviewee acknowledged innovation as 'ideas coordination' within their internal market, and with the external market, stating:

> "...let's go to the heart of the issue, and that's ideas generation. We do some in a coordinated way, recognising that ideas are not

> the monopoly of senior researchers they can come at any level...we also recognise that the best ideas are never ones created in isolation so it's because researchers or technicians are rubbing shoulders with our usual customers or potential new customers that they co-invent an awful lot of stuff with those customers or with each other...so I have multi-disciplinary teams... that's how I've set the teams up."

The absence of documentation in support of a centralised innovation process, and analysis of interviewee transcripts showed that, inductively, there was no *prescribed* format or process for managing innovation and ideas capture in *Case A*. When taken together with the researcher's reflexive observations, this suggested that not all of the firm's innovative thinking and technological ideas generation would be available to exploit in external markets and networks. Responses as to "whether it was possible to look into the organisation at any point in time and know what innovative ideas were in the melting pot" demonstrated that, indeed, it *was not possible.* Supporting this, one interviewee stated:

> "No not really…you only hear about the stuff that people want to talk about and you only hear about the stuff people who you have contact with want to talk about, they might have something fabulous going on at the end of the day and I wouldn't have a clue and it might impinge directly on what we are doing."

Another interviewee suggested that there were probably many 'ideas' residing with individual actors, but there was no mechanism to identify and then develop these ideas:

> "Ideas...there's is a pile of ideas, there's the issue of where it goes next and I think the issue of where it goes next is a lack of focus and so then you say okay someone has been quite good at focussing and so therefore why hasn't that innovation moved on a bit further...."

Perceptibly, the lack of a coordinated approach towards identifying, nurturing, and managing innovative ideas has significant implications for the role of marketing. If innovative ideas were not captured, then it would not be possible to match potential technical capability to perceived customer problems and opportunities. Neither would it be possible for theses 'ideas' to provide innovative 'step-change' products, processes or service opportunities for customer markets and networks. Effectively, by failing to maximise the capture of innovative ideas, ultimate technology transfer potential were being reduced, and opportunities to expand the firm's technological and market knowledge was being curtailed. The result of this failure to catch innovative ideas and evolving technological knowledge would be a missed (marketing) opportunity to develop revenue streams from the exchange of new knowledge and innovative technology products and services.

Importantly, the lack of ideas capture may inhibit the firms marketing function from acting as 'mediator' between prospective customers and the firm. Most respondents suggested that feedback from 'the market' can influence the direction of technical effort, but a problem arises if marketers are not aware of new innovative thinking and developing technical potential within the internal market. In this case, technical innovation occurs in isolation of the market, and the opportunity is lost to mediate a tailored technology solution, in turn reducing the likelihood of technology transfer. The problem is further compounded with missed marketing opportunities to 'group ideas together' and create further technological and market potential. Significantly, several interviewees described the benefits of 'market(ing) input into innovation effort. In response to the question "what role might marketing play in innovation effort", one interviewee suggested that:

> "Oh it's important as actually doing the actual development itself because again if you don't have a clear description of the attributes that's being...that the user wishes to have in that particular adoption then you come out with something that doesn't align with the way they may use things."

Similarly, another interviewee described how 'feedback' from the market was important to innovation, stating that:

> "Well what we have found it is that the people who are closer to the commercial front end than ourselves are good at indicating what probably won't work because of things we wouldn't have thought of in the way clients or the public would react to it".

5.22.2 Technology Development

While *Case A* could lay claim to success in the application of its science output to industry and end-consumers over many years, it was not however exempt from the difficulties and requirements of managing technologies in development.

The technology management literature suggests that ‘best’ practice management of technology development involves use of ‘stage-gates’ through the various development stages from ‘proof of concept’ through to ‘market readiness’ (i.e. before transfer and commercialisation). The development stage is arguably the most critical time for overall technology transfer levels with problems of technical failure, resourcing, or inadequate market information and connectivity all contributing to failure rates exceeding 90%. Unsurprisingly, most respondents referred to this phase as the ‘valley of death’.

However, what was of interest to the study were questions relating to the actual activities and practices associated with the development phase, and the activities and practices that indicated interviewee attitude and approach toward marketing’s involvement.

Reviewing *Case A* documentation revealed no overarching technology strategy. Neither did it reveal a firm-wide approach to managing technology development through use of ‘stage-gating’, where both technical and commercial criteria dictate the progression of individual technologies through to commercialisation. This is particularly important because, as the literature and practitioner themes attest, (i) early kill decisions conserve resources, and (ii) strong links to the market improve technology transfer success.

Interviewee responses to the question “does the firm use a stage-gate type system for managing technology developments” confirmed that while project management was occurring, the experience of the actors was that stage-gate type processes that facilitate collaboration and knowledge exchange between science and marketing during technology development were not evident. Interviewee responses to support this finding are set out in Table 5-2:

Interview Extract	
	“Not formally…I think that that actually is happening but not formally.”
	“I should be crossing myself saying something like that (stage-gating)...no I would definitely give it a very wide berth… I just think you can get…the whole idea of product management can become all consuming so much so that you lose sight of actually what the project is all about…”
	“Yes I think it is. I think in terms of managing whatever is prescribed and I’m stating that I think we are deficient but where there has been internal investment I think that there is quite a good process in place for project management.“
	“It obviously varies from case to case but I think as a whole...I think it’s probably fair to say that there’s weak processes there and I think it would be easy for us to point at processes that sit inside the organisation and milestones and review

	points that occur for all of our projects...but if we were to put hand on heart and say we were strongly process driven I think we would be lying”.
	“Well it is common because it is imposed on us by management but it is undoubtedly constructive…however the best experiences I have of commercial partners is to toss it all to one side if something lights up in terms of an area of work that is proceeding more rapidly and they’ll say well forget the rest of it and go with this and it is quite rewarding in my experience.”
	“It’s almost entirely dictated by funding, it’s very rarely a scientists call to stop the project...in a way it’s like getting them to cut off their own hand...a scientist...to basically reluctantly and usually kicking and screaming stop working on something if someone basically decides, is brave enough to stop the funding for that...but like any organisation and this is not unique to research funding at all I think its unique to every project if it’s hard to sort of actually recognise a bad project and stop it early enough and certainly within CRIs we often find it even if we recognise that our budgets are bad the incentives are not there to actually stop it we’re better off to try and basically fool our customer into thinking the project is okay and continue to have them fund it and there are a number of cases when if we have to be brutally honest we are actually continuing to basically propagate bad science simply because we can get funding for bad science for some reason when we think there is better projects we could be doing that we can’t get funding for.”

Table 5-2: Representative Quotes Concerning Use of Stage-gate Methodologies in Technology Development

The point here is that technology stage-gating provides feedback to and from the market to increase the likelihood of technology transfer. Where limited activities and processes exist for cross-functional knowledge sharing, marketing staff are less able to feedback customer ‘wants and needs’ to influence technology attributes, and are less able to take firm technological knowledge and know-how into the market. Moreover, an inability to look across the spectrum of technologies under development prevents marketing from packaging and bundling select technologies and technological knowledge to create further market opportunities, in turn building further technical and market knowledge and capability.

Significantly, analysis of the raw data illuminated an ‘empathy gap’ between the science and commercial functions, with both exhibiting less than complimentary attitudes and understanding toward the other. Science respondents showed a level of cynicism regarding the need for marketing involvement in technology development, where marketing respondents were fearful that scientists would jeopardise technology commercialisation through a lack of knowledge of market ‘wants and needs’. One respondent even suggested that the failure of technical and marketing functions to work together was “*the*” barrier to innovation. This is important to the study, because it underlines the author’s assertion that marketing continues to be misunderstood, and that its role in technology transfer is not clear. Examples of respondent attitudes supporting the ‘functional divide’ between marketing and science in *Case A* are presented in Table 5-3, below:

Interview Extract	
	"I have very little contact with marketing people themselves, but I speak with commercial people who have access to marketing people. I think they talk to salesman which is not the same, and my experience is… is that counterparts in the private sector are themselves somewhat cynical about their marketing people."
	"What I believe firmly is you can't just hand these things over to marketers or engineers or whoever the folk maybe and let them run with it."
	"I would change the entire customer management responsibility from the science to the commercial group. I think a lot would follow if...if we make that change."
	"...we don't usually involve the marketing people."
	"It's one issue that we started to work through....it's simply I think the company is still full of scientists and as long as they have written their idea in some report or some paper and sits there as a conclusion they've done their job....so they've passed the pill and as it happens to be as far as they are concerned...there is no receiver there to catch the pill."

Table 5-3: Representative quotes concerning the 'functional divide' in Case A

Interestingly, when science respondents were asked if there was science benefit in spending (more) time in the market – all agreed; similarly, when commercial staff were asked if there was marketing benefit to (more) time spent 'in the lab' understanding technical considerations, all agreed. Effectively, the perception of most respondents was that there were technology transfer benefits to be gained by working across 'functional lines'. This was found to be a theme across the study.

Distrust of marketing and a lack of entrenched stage-gate methodologies did not mean however that the market was excluded from the firm’s technical development, and that marketer’s were not engaged with external markets. In the main, respondents saw the need for heightened contact with the market and the usefulness of ‘competitive intelligence’ and ‘network relationships’ to influence technical development. Documentation and site observation determined that multiple R&D teams were engaged, to varying extents, with their external markets and networks.

What was of interest to the study concerned the nature of the activities and practices (phenomena) that illuminated marketing’s role in the firm’s development effort. One interviewee described how customer contact made it possible to gain a greater understanding of customer technical needs, stating:

> “I guess we are very lucky we work very closely with an industry and tend to be very innovative in the way that they operate anyway. So what we tend to do is…it’s a sort of coming together and listening to what may be of use to our clients and also looking for opportunities…”

Another interviewee described how a cross-functional approach to technology development ensured that the resulting technology ‘value proposition’ had a greater chance of succeeding with the customer, stating that:

> "The ideal situation...I believe the best scenario if you like is for a senior scientist and/or the scientist who has developed any given technology to actually go out into the market place with a business manager and probably fairly early on in the piece to introduce in sort of two phases... here is the science, here is the business package together this is the value proposition and are you interested in this."

Another respondent described how, in an ideal world, it might be possible to maximize technology development potential by promoting partnership between technical and commercial functions, stating:

> "I would develop a structure that brought commercialisers in with researchers and through partnership where there is...where science were given the sort of rewards they're looking for which aren't usually financial and the commercialisers felt that they could trust the scientists to look after their interests which are usually purely financial...and if you could get that true trusting partnership going... limitation will always be the finances... but as long as there's an open trusting partnership between commercialisers and the researchers I think you're most of the way towards overcome all probably all of the issues that any project faces and it's based on that partnership between commercialisers and researchers, and co-incentivisation...but never assume that that's just money, it's not...especially with scientists it's not."

The need for resourcing technology development was a theme with *Case A* interviewees, who referred to resource considerations 59 times. Resources were required in order that science and commercial endeavor could continue, but in a competitive environment budgets were constrained, technology development had long lead times, and engagement with the market came at a price. For the respondents, a lack of resource meant that certain projects could not proceed, time could not be allocated, and opportunities for basic discovery and innovative thinking were curtailed. “Difficult to find funding for it” and “we don’t have the flexibility within our group in terms of our funding” were typical responses to questions concerning interviewee experience. Furthermore, because science staff outnumbering commercial staff by a ratio of approximately 50:1, it was not always possible for technical teams to gain access to marketing resources. Given this experience, resources for marketing were scarce, further distancing technical developments from the market.

For most science respondents, lack of ‘marketing resources’ for innovation activity meant that market ‘intelligence’ was inadequate. Consequently, customer and network problems and opportunities were not being researched, and opportunities for collaboration and partnership were not being realised. Neither was the firm’s developing technological knowledge being exposed to the market place. Supporting this, one science leader described this need for marketing resources in innovation by stating:

> “I would like to see us take a much more disciplined approach to technology transfer through structuring our understanding and our processes in a value chain framework...so I would be wanting to lodge in there the knowledge about rates of product flows and the issues about information exchange, the areas about partnership alignment compatibility, then if I did that and had a decent dossier then I think that I would have a lot better understanding how then to more wisely move and be able to hold and capture that information.”

Similarly, another interviewee stated that:

> "No I think it is disappointing position and what I think, why I say that is it simply means that we've got researchers working in a naïve state..."

The conclusion here is that, despite general acknowledgement by the respondents that cross-functional engagement to effect market and technical alignment was perceived as a useful - if not vital - aspect of technology development, there appeared to be continued misunderstanding and mistrust between the functions, and this together with "insufficient marketing resources", was limiting technology transfer in the firm.

5.22.3 Technology Transfer

In *Case A*, technology transfer activities were managed by the 'Commercial Group'. It was this Group who were charged with the responsibility to "reach back into science" and take identified technology potential to the market by e.g. transferring new technologies to existing businesses, establishing new trading entities, licensing intellectual property, or by jointly developing projects with external clients. In the main, this meant that the Commercial Group were focused on their own (market) relationships, while the science staff were focussed on their own (technical) relationships.

As might be expected, the processes associated with technology transfer were seen primarily as 'commercial' among the respondents, requiring skills and competencies that were perceived as different from those associated with 'science'. This perception was reflected by two interviewees, who stated:

> "We are scientists we are not commercialization agents so we look to them [marketer's] to peruse the commercial entity role."
> "...so we don't do our own commercialisation, we try not to go any further than the initial prototype..."

However, this was not to say that the interviewees perceived that scientists should leave commercialisation to the marketers. If it could be said that *marketing* had a role in the innovation and development processes, then phenomena associated with the transfer phase indicated, conversely, a role for *science* in the commercialisation process. For example, most *Case A* science interviewees described concepts of 'partnership' and 'relationship' with marketers and external customers as key resources in the transfer process. One science respondent described the level of science engagement in the market by stating:

> "Well, typically we tend to work fairly tightly with our key customers."

In essence, *Case A*, technology transfer was not necessarily seen as 'best left to the business development managers'. Rather, internal and external 'relationships' and 'cooperation' were being articulated by all respondents as important to the firm's technology transfer effort. This might suggest that science too, was going through the 'epochal change' experienced by marketers, with the internet, global interconnectedness, the importance of technological knowledge, and non-traditional networked relationships, all challenging the views of how R&D could be organized and practiced. The point here is that technical relationships in a new economy environment reflected actor involvement in networks that placed increasing emphasis on the transfer of technological knowledge. For the firm, the process of technology transfer now concerned the transfer of technological knowledge internally through cross-functional partnerships and collaboration, and externally through technical relationships and collaboration. Transcripts describing the importance of relationships in the firm's technology transfer effort from the 'science perspective' are illuminated in Table 5-4:

Interview Extract	
	"I think it's very much about picking the right partner...so it's all about relationships, I'm quite convinced about that so if you happen to have a particular piece of technology or an innovation that somewhat radical...disruptive then you really need to be picking a partner that's prepared to either radically change their system or to in fact change their partnerships along the value chain...otherwise you deal with incremental stuff and it's just like another cake of soap, you are still washing yourself, it happens to be blue instead of yellow as compared to the totally new detergents...I think picking the right partner to work with...along the chain is really quite critical."
	"Again I think it's down to actually working very carefully with commercial partners, and selecting a team around that, having contingency plans in place and being able to respond to subtleties in the way the technology may be performing may or may not be performing, so we have been very lucky… I do think it is all to do with who you work with in that regard."

	"It's absolutely critical [relationships] and of course we're bad at it, but not so bad that we can't make a living. It think we could do a lot better, we tend to downplay it as you know, they'll forgive and forget, or we can pick up the phone, and it will be all be right again, but if we put as much time into relationship management as we put into trying to sort out all our internal issues, we probably would be a lot further to getting these technologies underway a lot quicker...so it is critical.
	"I think it depends what you are selling, if at the end of the day you are selling a [technology] product, then it probably would be appropriate for marketing and scientists to go hand in hand certainly when developing a new custom base, because I do think the buying comes from giving them some of the underpinning science behind it…it gives a level of confidence in what is being sold. If you are selling a knowledge type proposal which we do a lot of then I think it has to be the scientist who knows about the work and you have that passion about it as well."

Table 5-4: Representative Quotes Concerning the Importance of 'Relationships' as Resources for Technology Transfer in Case A

5.22.4 Technology Diffusion

The idea that, after technology transfer and commercialisation, there should be continued focus on the customer through ongoing technical and marketing effort so that future 'iterations' of the technology - or new technologies - could be transferred, is not a concept that was evident in the data or observed by the researcher. This was not to say that ongoing involvement with existing customers did not occur in the firm, quite the contrary, but rather specific reference to the concept of *diffusion* was not evident. Indeed, in all of the transcriptions from *Case A*, and in firm documentation, the concept of diffusion occurred only once.

The suggestion here is that the concept of diffusion has not changed; rather its modus operandi now involves expansion and development of inter-firm technical and commercial relationships, with collaborative effort becoming the vehicle for ongoing technical and commercial involvement with existing customers. In this way, technologies are diffused into the customer organisation through ongoing technical 'relationships' and 'collaborative effort', as opposed to periodic and intermittent introduction, commercialisation, and diffusion effort. This is an important consideration for marketer's because, where in the past diffusion effort - or customer follow through – was primarily a 'marketing function', now phenomena associated with *Case A* was suggesting that diffusion effort had become a cross-functional consideration. For example, when questioned as to the 'extent of *scientist* involvement with the market', one respondent stated that:

> Many do. Many are far more practical in the market place than our commercial team. Our commercial team have administration functions as well as a marketing function and so a lot of them, a lot of the commercial team are not actually as market oriented as many of the scientists...certainly talking about the team leader level, our scientists are actually very, very strongly market facing in a number of areas."

The argument here is that scientists, like marketers, operate in a new economy environment characterised by the expansion of inter-connected industry networks, and by increased emphasis on the innovation and application of (technological) knowledge. Naturally, these networks of relationships include the firm's marketers, and as a consequence, new opportunities for marketing and technical knowledge exchange are being presented. It is this cross-functional exchange of ‘technological’ knowledge that points toward an evolving role for marketing in firm technology transfer.

Table 5-5 summarises the occurrences of phenomena, concepts, and categories that emerged during thematic analysis of *Case* A interview data. Part of this process involved the technique of ‘word counting’, and while not completely desirable in a qualitative study, nevertheless presented an opportunity to assess the frequency of phenomena with the concepts and categories that had emerged from other data sources. Miles and Huberman (1994) describe this process as “looking for recurring phrases or common threads in informants accounts” (p. 70). Use of the ‘matrix analysis’ technique then allowed the study compare and contrast the data sets from each *Case* firm, laying the groundwork for the pattern analysis described in Chapter Six.

Technology Transfer Phenomena	Total	Science	Market	Concepts	Categories
Resources	14	14	0		
Funding	38	16	22	Firm resources	
Prioritisation	2	2	0	Technical resources	Resources
Compete for resources	5	4	1	Marketing resources	
Ideas	38	31	7		
Knowledge	47	37	10		
Intellectual property	14	10	4	Innovation	
Technical knowledge	1	1	0		
Market intelligence	4	3	1	Technical knowledge	Technological - knowledge
Technology	64	59	5		
Innovation	46	29	17		
Technology development	7	7	0	Technical innovation	
Technology transfer	4	3	1		
Technical attributes	5	5	0		
Science	66	48	18		
Technical capability	4	0	4		
Joint Ventures	1	1	0		
Relationships	29	19	10		
Team	42	29	13	Collaboration	
Partnerships	10	10	0		
Trust	8	8	0	Partnerships	Relationships
Network	2	2	0		
Cross-functionality	3	3	0	Cooperation	
Communication	4	4	0		
Consumer	10	10	0		
Market	88	71	17		
External market	36	31	5	Market networks	
Customer	77	29	48		
Value chain	11	11	0	Internal market	External market
Marketing	42	33	9	External market	
Skills	4	3	1		Internal market
Change	36	32	4	Value proposition	
Knowledge economy	7	5	2		
Information	24	23	1	Technology transfer / commercialisation	
Internal market	20	20	0		
Value proposition	7	6	1		
Value	27	16	11		
Commercial	87	56	31		
Sell	15	15	0		
Product	78	74	3		

Table 5-5: Summary of Case A Interview Data

5.3 Case B:

<u>*5.31 The Firm Perspective*</u>

First observations left the researcher in no doubt that *Case B* was a science institution given that the signage and livery at the campus entrance, car park area, and the main administration building all reflected the firm's scientific and R&D intent.

The interviews were conducted in private in each interviewee office, with most respondent's providing company documentation relating to the firm's science and commercial 'plans, reports, systems and processes'. Additionally, the researcher spent several hours touring the 'R&D facilities', observing firsthand the activities and processes surrounding technology transfer effort. This engagement with the actors in the research setting, and subsequent thematic review of the firm's documentation, assisted with identification of themes and concepts and began the analysis process.

At the firm level, analysis of planning documents recorded strategic level goals for each of the key science and technology 'platforms'. Thematic analysis of these documents illuminated the strategic intent of each science group, and more importantly, reflected themes and concepts associated with the firm's strategic intent to build technology transfer capability. Specifically, concepts of 'partnership', 'teamwork', 'technological development', 'commercialisation', and ‘resources’, were central themes in the data, with each of these themes supported by a pattern of interconnected sub-themes relating to technology development and commercialisation (Figure 5-3). Supporting these themes, documents from the executive team’s end of year functional reports also reflected the firm’s desire to increase resource allocation to technology transfer effort, and promote partnerships and commercial relationships. The documents reinforce the conclusion that promulgating these concepts was a vital part of the firm’s technology transfer effort. Excerpts from these reports are presented in Table 5-6.

Function	Excerpt
GM Science	...”this has enabled us to develop a number of new partnerships and programmes. Also of note during the year was an increase in collaboration with other Crown Research Institutes, which is contributing to valuable sharing of ideas and resources.”
GM Investment	“There has traditionally been a shortfall in funding at the crucial start-up phase of new business.”
GM Strategy	“...grow our leadership in R&D by integrating capabilities across the value chain and by working in partnership with industry.”
GM Market Development	“...we strengthened our industry and commercial relationships and focused on building long term research relationships of value to all parties.”
GM Finance	“With growth comes the need for finance and administration systems that streamline business.”

Table 5-6: Reported Themes in Case B Technology Transfer Strategies

The point here is that documents recording *Case B* strategic intent, and in particular the innovation and technical development strategy, all affirm an intent to develop and transfer technological products and services, with the concepts of 'partnerships', 'cooperation' and 'resources' significant themes throughout the text.

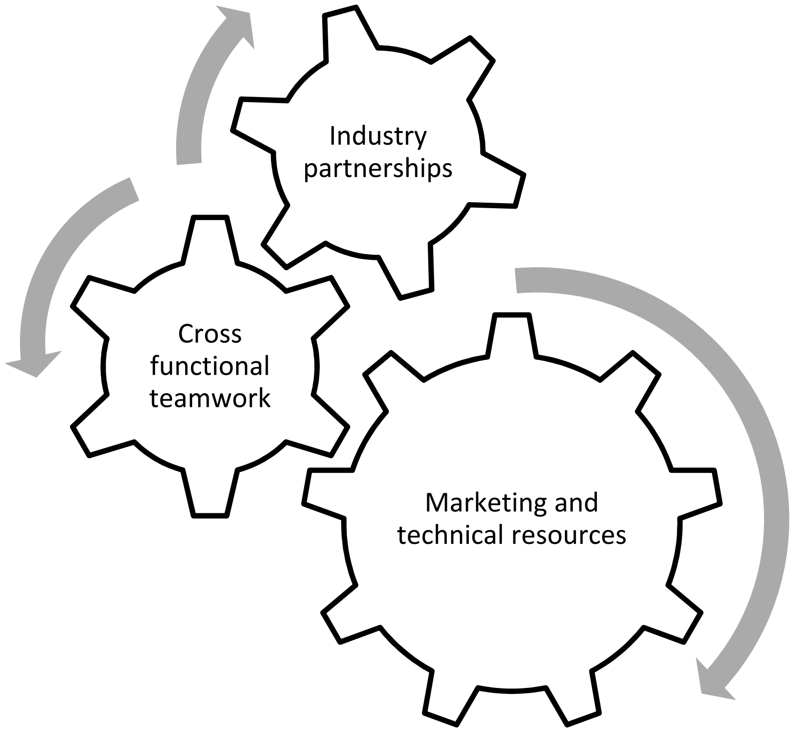

Figure 5-3: Case B Technology Transfer: the firm perspective

5.32 The Actor's Perspective

Supported by field observations, analysis of the interview transcripts allowed the study to compare and contrast the actors subjective experience with the themes and concepts developed from firm documentation. This analysis technique allowed the study to interpretively develop marketing themes and concepts from both data sets so that marketing's role in the firm's technology transfer effort could be illuminated. It also allowed for further development of the concepts and patterns that emerged.

5.32.1 Technology Innovation

Case B innovation activity was built on an established internal processes' that encouraged staff to bring forward innovative ideas, which depending on peer review and opportunity assessment, could attract internal resource for further technological development. However, while this process had been in place for some time, it was considered by the actors that the process was not delivering the volume of innovative ideas that were expected. One respondent described this difficulty in attracting innovative ideas, by stating:

> "I'm not convinced I have a rich pipeline and to get my pipeline richer I've had to increasingly get deeper and deeper into the organisations to where the ideas are being generated because at this stage it's a type of journey and it's often difficult to work out where it can go, but try and mould the scientists into thinking more commercially and more market focussed with more market information and stimulate innovation down there."

This was not to say that innovative ideas did not exist, rather that the innovation processes were not yet tapping into the firm's innovation and technological potential. For marketers this is important because, in the new economy, the transfer of technology products and technological knowledge have become important to firm profitability. Without an ability to identify the extent of the firm's technological knowledge and technical capabilities, opportunities to expand and develop new technologies are lost. So too are opportunities to develop new technical and commercial relationships and networks. The data suggest several reasons for this lack of engagement with the firm's innovation processes. Firstly, it appears that cooperation and networking is still limited among the various science and technical teams. For example, two respondents stated:

> "Now often and with any structure you have the danger of silos where people operate only when they're in their own environment, talk to their own people, and we're missing out on what I would say is a rich opportunity around cross capability, cross fertilisation across our teams in bringing things together."

> "We encourage our team members to work across team with other people and they haven't in the past."

Secondly, capturing the firm's innovation potential was not just a challenge for the function of 'science', but one for the 'marketing' function as well. If it is accepted that knowledge of markets and networks are important to technology innovation, then the objective of its marketer's must be to gather and disseminate market 'intelligence' so as to influence ongoing technical development toward meeting customer needs. However, if marketer's are not aware of the firm's developing technical capabilities, they will be unable to provide 'intelligence' to influence technical effort, and opportunities to establish new cooperative relationships will be lost. Reinforcing the idea that marketing has an important role in technology innovation, one science respondent stated:

> "...and so obviously it's important to take them [customers] along with you… because if you produce something at the end of the day that's not something that they really want … it's a bit crazy. So the sooner you can get them on board the better...there are some very, very innovative clients who give you very good feedback."

Thirdly, marketers themselves are also responsible for developing innovative ideas and innovative application of the firm's technologies. Market engagement, networking, and relationship development provide marketer's with significant opportunity to identify solutions to customer and industry problems, further reinforcing the need for marketing knowledge of firm technical capability. The suggestion marketing can be important in promoting and developing the firm's innovation capability is reinforced by another science respondent, who stated:

> "...its often the businessman or a commercial person who's got a clever idea which is based on some market information and he may want to research it, spend time doing a bit of market research, or write a business plan or work with the scientist to try and engage on this idea, so it sort of comes from the other end of the market pull so ones very much science push and the other ones market pull."

5.32.2 Technology Development

Given the high failure rates in technology development and transfer, it was not unexpected that *Case B* would similarly struggle. As with many firms pursuing multiple technology *development*, the challenge for *Case B* was transferring technical innovations from proof of concept to full commercialisation. For the respondents, this phase always took the longest, always consumed the available resources, and when customer needs were not met, technology developments either languished (consuming more resources), or were terminated. Unsurprisingly then, respondents referred to this phase as the “valley of death” and acknowledged the importance of ‘stage gate’ type processes for managing technologies through the ‘pipeline’. For example, one interviewee commented:

> “Well it’s not only about increasing the flow through, it’s identifying the right things that shouldn’t go through, right, so what’s the process that you’ve got on this side of the valley of death to make sure that you’ve got the absolute best opportunities that you are wanting to flow across that, and have you got the bridge there, for example, the funding support, the resource support to get you across there, so there’s no way that the big what I would call the highway of science capability that approaches the valley of death should expect to go across the valley of death.”

The identification of ‘best opportunities’ is however, dependent upon the firm’s marketer’s providing a clear understanding of the customer’s problem (or opportunity), and then applying the firm’s technical capabilities to meeting these needs. The data suggests however, that achieving this ‘state’ was an issue for *Case B* with interviewees referring to the ‘gap’ that existed between scientists and marketers, reinforcing the study’s assertion that the function and benefits of marketing continue to be misunderstood. Indeed this mistrust of marketing manifested in one respondent describing market intelligence as ‘hype’ and ‘rubbish’:

> "... and scientists they analyse, they want to know whether the information is robust and they'll ask all the hard questions and they're the first to see through marketing information that's got hype in it. So the sceptics say its rubbish. And so you've got to make sure what's being presented has seeds of truth in it. It's connected to reality, and the scientists of the organisation will ask these questions. So we keep each other in check, so that business managers draw out the marketing opportunity out of our scientists. And our scientists analyse it like crazy and draw out reality."

Similarly, another respondent described the reason for this functional gap by stating:

> "...there's still a persistent view that commerce is a dirty thing and science is a high level activity."

The conclusion here is that technology development is, to a significant extent, reliant on achieving a level of cross-functional cooperation to ensure that technical developments are matched to customer needs (or wants). Failing to establish these functional relationships ran the risk of adding yet more development bones to the valley of death.

5.32.3 Technology Transfer

Observations and document analysis had shown a clear intent by *Case* B to transfer and commercialise technology products and services. This 'firm level' intent was also evident in comments made by the interviewees. For example, two scientists stated:

> "There's been a huge change in the commercialisation process but it's rapidly developed in the last four to five years...the messages from our upstairs our groups and from our team leaders... from the management team I guess, and celebrating successes. Yes it depends on the enthusiasm of the individual obviously... still the business managers have a huge role to play in guiding the whole process."
> "I think it's pretty good overall, there's been a huge swing to the idea of patenting and just commercial return on scientific ideas as opposed to even five or ten years ago where it was very much the publish or perish idea. It's important to science and to scientists that we do continue to publish, but I don't think now amongst a lot of us that that's the first, we're now thinking about our new ideas and we're thinking of sort of IP protection."

However, the commercialisation process involves gathering market intelligence from the field, establishing networks and relationships, and developing customer technology value propositions. It also requires significant marketing resources, and despite general agreement that revenue streams from technology transfer were important for firm success, resistance from science groups regarding the purpose or usefulness of the marketing function was still evident. For example, one respondent stated that:

> "I mean there's certainly been a lot of discussion I suppose about the size of that resource relative to the science resources...so its dragging money out of what someone claims is a real science. So again it's about, as I say, and I've been fortunate in my particular area that I've always had this [technical] group, they're not a large group but there's you know I mean three or four of them they cover a range of tasks and so our effort has always had this overhead if you like on it and I think the rest of Institute the rest of the science has probably regarded themselves as more pure scientists I mean their output has been in the knowledge area until relatively recently when they tried to commercialise some of that knowledge...but to do it you need business managers, now

> there's been this tension I suppose between those scientists who suddenly see all these business managers around the place and the associated cost of them, thinking that you know that's taking funds away from their science."

Similarly, another respondent stated:

> "Okay, I suspect most of the market is reactive, in other words a product might be around and they'll go and try and see what the market will stand. They don't necessarily go into the marketplace first and find out what the market wants and then come back to us and say has anybody got any ideas. I understand that the Institute is moving towards that but I haven't seen that. There is a major disparity between what the business managers think they do and what we think they do."

Paradoxically, this thinly veiled distrust of marketing did not dissuade science respondents from ready acknowledgement that internal and external relationships were important in technology transfer. Illustrating this contradiction, Table 5-7 provides interview extracts from scientists describing their need for *internal* (cross-functional) relationships, where Table 5-8 provides extracts from scientists describing the importance of *external* (customer) relationships.

Interview Extract	**Scientists and the importance of internal relationships**
	"As far as possible the proximity thing, and just you know the businessman really has to understand the sciences, you know, so he's got to spend time, he's got to be part of the team. I know there's a business manager group here, but I think if I was a business manager I would first and foremost I'd feel I was part of a science team, rather than a business team. That's certainly how I would try and tackle….and then come

	together with the other business managers, that’s fine, but first and foremost they're representing whatever [technical] group they work with rather than themselves and the other business managers.”
	“A pretty well rounded individual, I mean someone who knows the science, I mean first and foremost I think we’re not in the business of used cars and so we make claims about things, they’ve got to be right, so that’s the scientist, you know he's got to develop the data, but then if, then the marketing will be a partnership again between the business manager and the scientist, but the business manager has to understand, so does have to have some knowledge of science I suppose depending on what area he’s in so you know whether they need a science background, they certainly need to be able to talk to scientists in their language and go some way down that knowledge and understanding. So they have to be able to do that, but they have to have all of that business skill, they have to be able to talk to businessmen with understanding, all the things that will allow us to make a buck...which the scientist mightn't have at all. He also needs to have probably...he has to have...he has to be able to stand back from the work…probably the same way we're talking about stop / go decisions that’s been hard for a lot of scientists to do that, we need to have systems and people who can objectively look at a piece of work and say well you know the market size is only this, that’s going to cost us this to get there…it’s just not worth it, it might be worth good science but somehow he has to put his commercial hat and explain to the scientist that we’re not going to make any money out of this, now not necessarily stop don't do the work you know, but then we're doing the work for other reasons, rather than the commercial dollar and everybody has to be able to understand that.”
	“Now I guess to date maybe it has, and I don't know when something comes back into profit but I would argue that they're critical, I mean either the scientist goes away and does it, in which case he's not at the bench or you get someone else helping you do it, so you can't get away from that...so I think it is critical that we have a mix… it’s critical that the business managers are as close to the science teams that they work with as possible and *vice versa*. My office is next to [the business manager’s] office and that seems, you know I'm the team leader of science [Fred’s] the business manager for us, we’ve got adjacent offices that are extremely close together, all of our strategic planning. Most of my industry visits and

	discussions with industry we do together, we do a lot separately, but we work very closely together and I think that model has certainly worked for us... and will work for others.”
	“There might be a business manager looking at taking that project through the commercialisation phase there will also be a technical manager appointed to carry through the technical side so the two work together the business side and technical people...teams work to make sure that the objectives that are set are on track and provide each other with feedback as to the way things are going.”

Table 5-7: Scientists and the Importance of Internal (cross-functional) Relationships

Interview Extract	**Scientists and the importance of external relationships**
	“Well you get much more information out of companies if you’ve got a good relationships with them and you get earlier support... they can see, it depends on the nature of your relationship I suppose obviously if they are investing in a programme they.. you get earlier support through that…. and you’d have much more formal systems when that’s in process...it just an industry connection. If you’re going to grow and increase that relationship in any particular way then it’s got to work.”
	“So if we didn’t have long-term relationships and our strategy is about growing more and more of them, the more deep the better, we would be sunk. So we look after our clients. We do client satisfaction surveys and our business managers that are identified as gate keepers for those key clients. It’s all around the relationship development and cultivation, feedback from them.”
	“Get that industry on board because they’ve got all the processing…It’s much easier when we’ve got that investment or that relationship with someone out there if they're in there, feeling like they are a partner, or part of the process with you, you’ve got to capture the market…and you understand what they want so there's no race, you know you're not fronting up with something that actually they don't want, you know because they’ve been with you right at the beginning, by the time you’ve got something they want it.”
	“It’s critical, because if you don’t have those relationships you’re not going to be able to get your applications supported

	by the stakeholder or the end user and so really it comes back to knowing what the customer wants and then coming back down and being customer driven rather than being technology driven."

Table 5-8: Scientists and the Importance of External (customer) Relationships

A conclusion here is that marketing's role in *Case B* technology transfer is misunderstood by other functional groups. Scientists were on one hand mistrustful of marketer's influencing technology development, fearing that science discovery and technical development would somehow be compromised; yet on the other, were manifestly uniform in their acknowledgement that, without internal and external relationships, technical developments would likely die in the valley of death.

5.32.4 Technology Diffusion

Since technology diffusion concerns ongoing relationship with adopting customers after commercialisation, the study was interested to determine whether phenomena associated with diffusion activities were present in *Case B*. Key marketing questions concerned the activities and processes employed by the firm in ensuring that 'the technology value proposition' was delivered on, and that opportunities for further development (i.e. version 2) were captured.

The interview data suggests the importance of ensuring that the technology benefits promoted by the firm (the value proposition) were in fact 'diffused' into the customer organisation. It also suggests that, in continuing the relationship, new market intelligence could be gathered, and further opportunities for technology transfer would be generated. For example, one respondent stated:

> "I think once you've got a product in the market that in itself gives you an opportunity to find new products rather than just dumping it, if you stay there with it you will hear, and it may be a subversive product to your own, but it could be a new product. And if you are close to the market, you'll know better than anybody else will."

Similarly, another respondent stated:

> "Because they need to know how the people out there... who might be using the science think. They also need to be able to see industrial processes, to know what the practical problems are they may be overcoming or can add value to overcoming...yeah can help to overcome. It's just absolutely essential I think."

This continuation of involvement with the customer after technology commercialisation is of vital importance to marketers. In addition to providing new opportunities for the firm's technologies, diffusion activity allows technical and commercial relationships to develop and strengthen, building intimate knowledge of the customer's business, and providing further opportunities for collaboration and innovation. Moreover, ongoing collaborative relationship with the customer can gain the firm unfettered access to customer networks, giving the firm's marketers opportunity to match and then transfer the firm's technological knowledge to solving network and supply chain issues. Table 5-9 summarises the occurrences of phenomena, concepts, and categories that emerged during thematic analysis of *Case B* raw data.

Technology Transfer Phenomena	Total	Science	Market	Concepts	Categories
Resources	10	7	3	Firm resources Technical resources	Resources
Funding	41	18	23		
Prioritisation	2	1	1		
Compete for resources	1	1	0		
Ideas	29	15	14	Innovation Technical knowledge Market intelligence Technical innovation	Technological - knowledge
Knowledge	39	23	16		
Intellectual property	35	17	18		
Technical knowledge	12	9	3		
Market intelligence	20	10	10		
Technology	51	29	22		
Innovation	64	36	28		
Technology development	34	20	14		
Technology transfer	1	1	0		
Technical attributes	0	0	0		
Science	142	68	74		
Technical capability	1	0	1		
Joint Ventures	2	2	0		
Relationships	16	8	8	Collaboration Partnerships Cooperation	Relationships
Team	101	61	40		
Partnerships	11	3	8		
Trust	4	2	2		
Network	2	1	1		
Cross-functionality	3	1	2		
Culture	12	2	10		
Communication	7	4	3		
Consumer	1	1	0	Market networks Internal market Technology transfer / commercialisation	Internal market External market
External market	80	42	38		
Internal market	4	3	1		
Customer	5	1	4		
Value chain	3	0	3		
Marketing	18	8	10		
Skills	6	3	3		
Change	10	7	3		
Information	46	24	22		
Value proposition	1	0	1		
Value	21	9	12		
Commercialisation	40	14	26		
Sell	13	5	8		
Product	46	44	2		

Table 5-9: Summary of Case B Interview Data

5.4 Case C:

5.41 The Firm Perspective

By 2005, *Case C* had implemented a new strategic direction, bringing with it a significant reduction in the number of science projects, alignment of those remaining with the new direction, and a business model that focused on "building stronger relationships" and "strengthening industry partnerships". Coincidentally then, the data from *Case C* was collected during a period of change – both in terms of scientific endeavour, and approach to 'the market'. Consequently, the study was interested to consider the firm's attitude and approach to technology transfer, and to compare this intent with the experience of the actors.

In addition to re-structuring its science effort, the strategy articulated an approach to technology transfer that, at its heart, was the establishment of industry and network relationships. For example, the firm's senior 'marketer' reported that creating wealth now involved:

> "...partnering with New Zealand companies to commercialise our programme outputs, whether it be [science] outputs or innovative technologies"....tying our research and development effort ever more closely to commercial outcomes"...."target strong revenue growth".

For *Case C*, the new strategy placed emphasis on establishing industry relationships to enhance knowledge transfer and technology uptake in its markets. It had also recognised that, for technology transfer to take place, collaborative effort would need to take place between the functions of marketing and science. Effectively, the executive had determined that if relational resources were developed, then market opportunities could be identified and technology products and services could be developed to match market needs.

This intent to foster a close relationship between the functions is reflected in the reported comments of the senior marketer, who stated that:

> "The [business development] team works closely with scientists to help identify specific market needs and set up appropriate commercial structures to take research outputs to the market."

The science function also reported a commitment to cross functional collaboration, although it was noted by the senior scientist that the new strategy, in addition to pursuing 'commercial' goals, would also pursue 'science' goals, and would involve the integration of the firm's technological knowledge:

> "To maximise its success, [*Case C*] also needs to optimise its resources, integrate its diverse capabilities and direct its science to achieve both scientific and commercial targets."

In many respects, the firm was beginning the new strategy with a metaphorical 'clean slate'. Science projects had been reduced, strategic directions for R&D had been determined, and resources for technology transfer had been re-allocated. Similarly, marketing effort had also been re-calibrated. A new 'strategic pathway' had been identified, technical development had been aligned, cross-functional cooperation was expected, and new external networks remained to be explored. The new strategy for *Case* C technology transfer is represented in Figure 5-4.

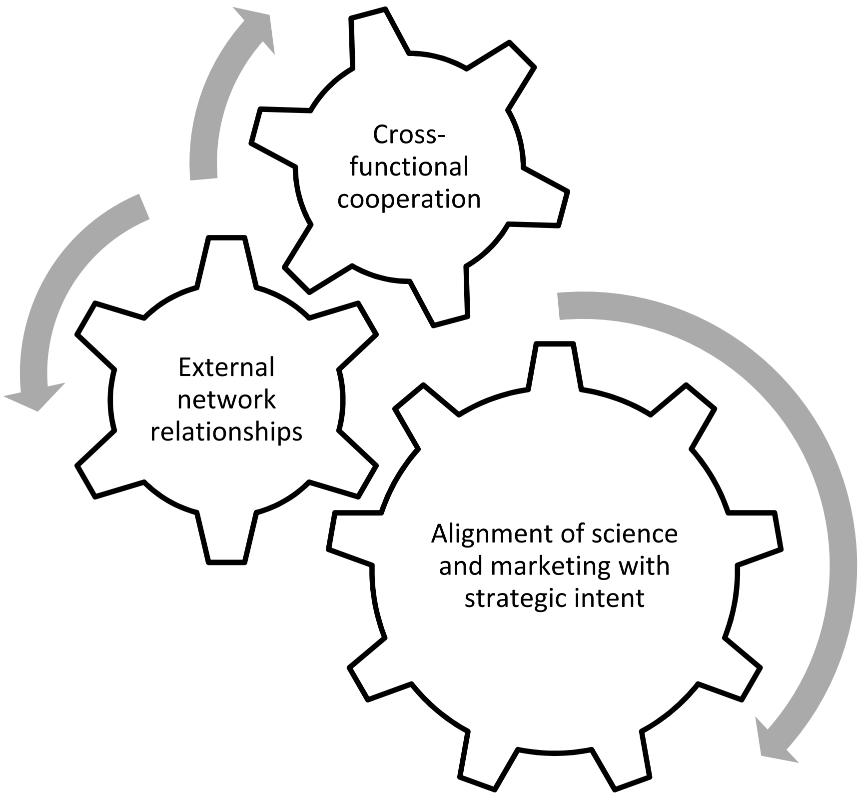

Figure 5-4: Case C Technology Transfer: the firm perspective

5.42 The Actor's Perspective

Perceptibly, the strategic direction brought new challenges for the functions of science and marketing. Since technology transfer effort was to be both collaborative and focused on 'new markets', there was an opportunity for the analysis to consider whether the phenomena in the research setting reflected the firm's strategy to promote *cross-functional engagement* and *external relationship development*. More particularly, it provided an opportunity to illuminate the interviewee's perspective of these concepts by analysing the raw data at each stage of the conceptual framework. In this way, concepts and categories pertaining to marketing's role in innovation activity could be theorised and developed.

5.42.1 Technology Innovation

From the perspective of marketing, cross-functional effort meant that potential technologies and technological knowledge could be recognised at the innovation stage as having market potential. Consistent with the firm's strategy, the objective for the marketing and science functions was to cooperatively develop the 'technology value proposition' by linking technical effort to potential market needs. However, this requires the firm's marketer's both gain access to detailed market intelligence, and then transfer this knowledge resource onto the technical teams. It also involves technical teams recognising the importance of transferring technological knowledge to the firm's marketers so that opportunities for technology transfer are enhanced.

The data suggests that achieving this level of integration, however desirable, was presenting *Case C* with some difficulties. It was one thing to invite marketing into 'the lab'- or to involve the scientist with 'the market', but it was quite another to expect that technological knowledge transfer across the functions would automatically take place. For example, one marketing respondent stated:

> "A lot of it is the big culture change because IP is something that people haven't thought about and it's also used a lot as a buzz word but a lot of people have no idea what it actually means, and getting scientists to actually recognise when they should be asking the question, not when they've done another year's work on it and told everybody about it, you know, how early on should they recognise what needs to happen. Yeah, when should they check things out, when should they get a business person alongside, also having now a greater need to check out the patent literature to see who else has done something, because in the past we've developed methods for New Zealand [customers] that can be done in New Zealand and other companies haven't patented it here and there's been no questions of if we're going to operate. The moment you try something offshore or provide a service elsewhere there's a whole new raft of things that they've never thought of before, so trying to get that recognition, that it is important and it needs to be integrated right throughout, really difficult."

Conversely, a science respondent stated:

> "Yea it should...I don't believe that the business development people that we have or that I see in New Zealand actually have a good understanding of what their roles are, and very often they, as I said before they come from a salesman background which is what is your product you want me to sell, and they now don't need you [the scientist] anymore. No understanding of what the dramas are, no understanding of the science involvement, no

> understanding what the opportunities maybe downstream from the discovery science."

The point here is that cross-functional involvement in innovation activity will be sub-optimal if the actor's roles are confused or where there is difficulty assimilating cross-functional knowledge. It will also be sub-optimal if the resources for cross-functional effort are absent, and in *Case* C, the raw data suggests this was the case.

This is important because resources are needed for marketer's to gather market intelligence and for technologists to develop the 'proof of concept' for innovative ideas. Table 5-10 presents typical responses to the question "what are the barriers to innovation activity from your [interviewee] perspective?"

Interview Extract	***Case C:*** **Barriers to innovation**
	"Never enough money and focus."
	"Number one stupid managers, number two poorly equipped business people viewing the next ideas, oh [expletive] here they come again, they are going to waste our time and we know we won't get anything from it."
	"They'll [scientists] struggle with all the things, all the non-science questions that come, that are asked about that, and that's when they'll need help in terms of how big the market opportunity is and whether there's conflicting IP in the area. That's typically where a scientist will struggle."
	"Frequently it's I guess either a lack of funding or the fact that the funding is very directed and we have gone recently into a period in our group where the funding is quite directed."
	"...you've really got to, I think, work hard to overcome the innate mistrust between the guys that wear ties and the

	people who beaver away in the lab you know. Here you are, you know nothing about science, who are you to tell me that my invention is valueless or whatever it may be. You're going to kill my project, I therefore won't be funded, my group will fall apart, you know all those sorts of things, so I think that whole sort of cultural aspect and the way perhaps that we managed our scientists in the past has been something that has been a real struggle for commercial people in this organisation to overcome."
	"I know in other commercial companies they establish environments where scientists can be more creative and they encourage their staff to spend a certain proportion of their time being creative, chilling out..."
	"I think what our mistake as a company is, or what we could be doing better as a company is somehow addressing that and giving scientists a little bit more freedom during the day to be able to tap into that because when we're dealing with very intelligent people we just need to be able to allow them some freedom to and generate more ideas."

Table 5-10: Barriers to Innovation Activity in Case C

The conclusion here is that successful innovation activity is dependent on functional collaboration. Without collaborative effort, innovation activity runs the risk of technical failure (innovation attributes are not developed), and market failure (the innovation attributes are not linked to market needs). Furthermore, the data suggests that innovation effort requires resources for technical *and* market development of the innovation, and difficulties arise where competition for resources exists between functional groups.

5.42.2 Technology Development

The new strategic direction meant that *Case C* technologies already in *development* were re-assessed against new technical and market criteria. The evaluations were premised on the idea that, at the end of the process, the firm would have a store of valuable 'intellectual property' and this, together with the firm's technological knowledge, would promote an ability to develop and transfer technology products and services.

However, this process was not to be as clear cut as might have been expected. For example, the concept of 'intellectual property' (IP) and its value to the market proved to be a significant challenge for the firm – even if the term itself was freely bandied about by the actor's. One respondent described how IP:

> "...was used a lot as a buzz word but a lot of people have no idea what it actually means".

Furthermore, stage-gate type processes with established 'gate criteria' were not spread throughout the firm, and as a result technologies with no clear market or technical potential, often described as 'pet projects' were continuing to consume resources. This is significant because, apart from consuming resources that could otherwise have been allocated to projects with a higher chance of technical or commercial success, 'escalation bias' impacted the firm's ability to align technical effort to the (new) strategy, impaired functional cooperation, and reduced the firm's exposure to (new) external market networks. Two respondents described the extent and impact of these issues in the firm:

> "We've had people who've had problems in our organisation trying to commercialise things and running into all the issues that

> should have been faced earlier...we're still trying to be strong on the developing the strength to kill things..."

> "I think it's pursuit of knowledge rather than pursuit of products or commercial things that is their driver."

The point here is that functional cooperation was required if the firm was going to identify and then quantify which of the firm's *cache* of IP could to be commercialised, and which development projects should be wound up, parked, or resourced. Without cooperative effort, technical developments would not necessarily solve customer and network problems, and R&D teams would be denied access to the types of market and customer intelligence that can inform technical development.

In sum, analysis of the phenomena surrounding the firm's technology development activity illuminated a lack of intent by the science teams to link technical developments directly to market needs. It was not enough to develop innovative ideas and register 'intellectual property' because this, in itself, did not provide the necessary links to customer needs. The data was suggesting that the firm's scientists had yet to accede to collaborative activity with marketers to ensure that existing and future developments were more precisely aligned to, and informed by, market needs. This assertion, that marketing could play a more significant role in technology development activity, is reinforced by two respondents, who state:

> "I think we need to be constantly aware of the market and who's out there, what products and what companies have, what their problems are, what products might meet their needs, building on from other relationships with them, saying if we could do this, you know, or what are the major problems that you have and I think linking into that market and early business thing is the biggest key..."
> "I think a lot of it is around, just providing that very cold hearted early stage sort of feedback quite frankly on, well sorry this goes in the dog and lemon file let's just not go anywhere you know, with this, for these reasons, it doesn't stack up financially, etc. etc. etc., so helping very early on to kill ninety-five percent of the ideas and being a very crucial part of that, I think would be the biggest sort of contribution that the marketing, so that encompasses the business people, the legal and intellectual property people and the communications people etc. can play."

5.42.3 Technology Transfer

For *Case C*, the new 'strategy' to promote external relationships had implications for technology commercialisation activity. Where in the past the firm had looked to effect technology *transfer* by developing commercialisable intellectual property, or by forming joint venture partnerships, the new strategy called for targeted development of *external* relationships in newly identified market networks.

Achieving this was however presenting the firm's marketing function with a number of important challenges. In the first instance, the analysis revealed that it was not easy to determine which technologies and technological knowledge had progressed sufficiently through development to be deemed 'market ready'. Two respondents supported this assertion, by stating:

> "In our organisation there hasn't been anything written down in terms of what everyone's doing."
> "...in my opinion is there are not a lot of experienced people around ensuring that the processes and the procedures are in place to capture the proprietary position...okay."

Secondly, determining which technologies that were 'market ready' pre-supposed, even if technical development was complete, that target customers or networks had been identified, technology attributes were matched to customer needs, and that technology transfer would take place. It also pre-supposed that marketer's would be able to recognise or understand the technical innovation and its applicability in the market.

From the perspective of the *marketing* respondents, these difficulties related to the perceived gap that existed between the firm's internal R&D effort and its understanding of the needs of the external market. As one respondent put it, this was not surprising:

> "Because number one it is not the passion or the main motivating driver of the scientist to take what they have discovered to a commercial stage."

By contrast, a number of *science* respondents suggested that this gap was attributable to a failure on the part of the firm's marketer's to grasp the 'technical significance' of developed technologies, and as a consequence, accurate assessment of the technology's market potential was not possible. This theme, that marketer's fail to gain sufficient technical understanding of technology developments is described by one respondent, who stated:

> "...and that's where it dies because the scientists have actually gone through [technical development] responsibly, which is a good thing but the commercial operations people haven't necessarily understood what they have been given and because of that we see a lot of scientists driven to actually try and continue to drive the commercialisation because they do understand [the need] but they don't have the skills."

The point here is that forming a detailed understanding of the technical needs of customers required inter-firm relationships that were sufficiently 'close' and 'trusting' that they allowed mutual access and sharing of sensitive operational, technical and commercial information. If the firm was not able to develop cooperative external relationships with customers and customer networks, then detailed 'market intelligence' could not be gathered, technology attributes could not be determined, and a robust technology value proposition could not be developed. Furthermore, fostering external relationships would likely involve engagement with the customer's operational, commercial, and technical functions – particularly when technology adoption would mean changes to customer products or processes. Thus gaining market intelligence and developing the technology value proposition would require inter *and* intra-organisational functional involvement, and if this was not able to be effected, then technology commercialisation would continue to be a difficult proposition.

Table 5-11 presents extracts from respondents describing the challenges for technology commercialisation effort:

Interview Extract	Case C: Challenges for technology commercialisation
	"We have to maintain momentum but what we need to be doing is picking out ten people out of different teams and sending them off to work in the food industry or the hospital industry and get some cross fertilisation of ideas and approaches in the ways of solving problems and we're just doing the same old mistakes, the same old things all the time. There's no oh [expletive], look that's how they do it, or the tourism, you know, they're leaping and bounding ahead and the scientists are just plodding. You know what are they doing different that we could be doing. We don't do that. We're too inwardly focused and we're too accountable, every hour, all year round busy and so there isn't that time to invest in sending people off to get those new ideas back."
	"...how competitive are we in this and how can we grow our market space, who are our main competitors and we rely very much on our business development team and we haven't done that very well in the past either and that's another area since we restructured and got our business...yeah, the whole development team there, they are very much supporting our science, because we're very challenged in that area. We think we have the right information and we think we know our competitors but I'm not convinced that we really do until somebody scopes it out for us and looks out there and works with us."
	"...if for twenty years you've been running the science and not been getting clear [commercialisation] signals then what's another unclear signal. Well they'll [the scientists] just ignore it or just keep doing it. And if we do get a clear signal well [expletive] that's a new thing so we'll just ignore that too, because, you know, we know if we ignore it nobody is going to re-emphasise it to us, so people have this ability to just beaver away and I think we realise that. But then again if you just, and this is the opposite actually, you just have a business plan and you only do what is in the business plan and you are going to miss opportunities in science. So there's got to be some middle, I mean I'm not sure we're in the middle at all.

	We're still...I think people are beavering away quite a lot."
	"I think the other thing is that is quite important is that, particularly when you're dealing with a commercial customer on a piece of research or a piece of technology, there's something of a fundamental disconnect between what they [customers] want and what we [*Case C*] want. You know at its crudest level, we want ongoing funding to continue to do research, they want real life viable products and they want them yesterday. We want to continue to throw money at something until we get the world's best mouse trap. They say sorry it was ninety-five percent two years ago, you've now taken it to a point where it's a thousand bucks a unit and that's the end of the story sort of thing and it's not viable and we could have done this two years ago, so there's a lot of difficulty around those sorts of issues."
	"... until our scientists are told... the science community realises that we can't afford that chasm there and that if you bridge that chasm we need industry alongside us and so we need some of that accountability in the short term...and that scientists are recognising that that is an essential part of their jobs. It's not been a part of their jobs in the past, so people do need some help and I think we're kidding ourselves if we say we can do it all ourselves where we don't need those tools because it won't happen without those tools. So we need those in the short term to get people up to speed with what is required to get a return on investment and I'm hoping that in the long term as the young scientists come through and they realise that this is the way science is done...."
	"In terms of strategically what business are we in, why are we in it, what is our value proposition, where do we want to be in x-years time, what are the chunks in terms of, that we need to add to the value chain, how do we add those chunks, who do we need to collaborate with, in what form should that collaboration take place depending on whether we're trying to produce you know, world leading capability for New Zealand products whatever it may be. So, there is absolutely no point whatsoever in sort of saying, right we've done five years of research here it is in a bundle, please go and sell it. It just doesn't work."

Table 5-11: Challenges for Technology Commercialisation in Case C

Similarly, other respondents described the difficulty that scientists face when seeking to develop relationships with external customers and networks:

> "Some people do it very badly and there is a consequence of that in that they will be excluded from things even when they are good scientists. They can be excluded for the wrong reasons, yeah, just because they are really bad at communicating and networking, so don't I think scientists are particularly good at it. I think for their livelihood if you aren't good at it then you are not going to be particularly successful."

> "And I'm not sure that that's the best use of our scientists, time to do that market development work. I think other people are better at that and we should partner with those and we should do the science and our finance people should do the finances and our scientists should do the science. And I think that scientists do all sorts of crap that they don't need to do."

In sum, the data points to significant issues facing *Case C* technology transfer and commercialisation effort. In particular, the phenomena experienced by the actors' revealed difficulties implementing cross-functional collaborative effort to ensure that technology developments were connected to market needs, and failing to garner these relationships would ultimately impact the firm's ability to develop commercial relationships with its external market. Perceptibly, there is a need (role) for the firm's marketer's to 'market the marketing concept' to the internal market so that the "chasm" between technical development and market needs might be bridged. In this regard, the senior marketer suggested:

> "So I think the marketing group has a really important job in terms of... if you don't gain that internal buy in to the strategy and all the rest of it, there's no point having lofty goals about

> what you're going to be doing and achieving in five years time. So I think that's probably the critical thing, yes."

5.42.4 Technology Diffusion

Analysis of *Case* C data showed that the concept of 'diffusion' was not a term that was used by the actors in describing ongoing customer involvement after the transfer and commercialisation of technology. In many respects, the historical reliance on intellectual property and joint venture relationships had meant that there was no compelling reasons to continue engagement with end customers – after all the sale had been made, and because there was a level of disconnection between 'science' and 'the market', there was no compulsion to ensure that the technology value proposition was, in fact delivering the benefits to the customer. This is significant for marketers, because failing to deliver on the 'promised technology benefits' would mean that opportunities for further technology innovation were lost, and more alarmingly, that repeat business would not be forthcoming from the customer. Table 5-12 summarises the occurrences of phenomena, concepts, and categories that emerged during thematic analysis of *Case C* raw data.

Technology Transfer Phenomena	Total	Science	Market	Concepts	Categories
Resources	2	1	1	Funding technology transfer	Resources
Funding	47	29	18		
Prioritisation	0	0	0		
Compete for resources	0	0	0		
Ideas	69	58	11	Innovation Technology development Technical knowledge	Technological -knowledge
Knowledge	37	23	14		
Intellectual property	27	29	56		
Technical knowledge	5	3	2		
Market intelligence	3	2	1		
Technology	33	24	9		
Innovation	25	18	7		
Technology development	50	36	14		
Technology transfer	3	3	0		
Technical attributes	1	1	0		
Science	141	114	27		
Technical capability	15	5	10		
Joint Ventures	6	6	0		
Relationships	10	7	3	Collaboration Partnerships Cooperation	Relationships
Team	37	32	5		
Partnerships	22	14	8		
Trust	5	4	1		
Network	7	6	1		
Cross-functionality	0	0	0		
Culture	5	2	3		
Connection	8	3	5		
Communication	10	7	3		
Consumer	2	2	0	External market Internal market Technology transfer / commercialisation	Internal market External market
External market	4	3	1		
Internal market	12	10	2		
Customer	11	6	5		
Value chain	1	0	1		
Marketing	36	27	9		
Skills	18	12	6		
Change	22	11	11		
Information	31	22	9		
Value proposition	2	0	2		
Value	16	4	12		
Commercialisation	94	57	37		
Sell	13	10	3		
Product	33	15	18		

Table 5-12: Summary of Case C Interview Data

5.5 Case D:

5.51 The Firm Perspective

Because the decade leading up to 2005 had seen *Case D* transition from 'producing science[30]' to 'developing and commercialising world class technology products', the expectation was that the new strategic focus on the development and transfer of technology would in some way be reflected in the buildings, presentation, and livery of the firm. This, however, was not the case.

Initial observations revealed that the primary research facility comprised a 'campus' of older buildings set starkly in an industrial area, the surroundings of which appeared decidedly low-tech. It was a case of the 'shop frontage' bearing no resemblance to the world class science and technology effort that was being conducted as part of a new firm strategy and business model.

Despite the lacklustre physical appearance, *Case D* was in possession of a 'bank of knowledge and expertise' built through a decade of contract research and development for public and private sector clients. According to the CEO:

> "The next step requires a significant shift in emphasis. It involves taking some of our science assets and commercialising them, not just in a consultancy sense, but creating new and stand-alone businesses that may, for example, involve manufacturing,

[30] Funded from the public purse.

> marketing of IP or some other form of related business enterprise."

For the CEO and Board, the new strategy had determined that two 'essential pillars' would enable the firm to derive value from technology transfer effort: 'excellent science' and 'excellent commercial practice', with commercialisation activity seen as 'every bit as much a discipline as the development of science itself'. The 'commercialisation' process, according to the CEO, was seen as having two starting points:

> "One is right science. The other is in the market rather than in the laboratory. It involves establishing customer need. The [business] model we have created blends the science, technology and business development elements into a single process."

The conclusion here is that, by identifying 'science' and 'marketing' capability as resources for technology transfer, and by matching 'science' to 'market needs', *Case D* was acknowledging that technology transfer was able to be effected through the collaborative effort of the technical and marketing functions. The firm was also acknowledging the importance of developing collaborative external partnerships as resources for commercialisation. Indeed, the overarching focus in the firm's technology transfer strategy now involved development of relational resources through internal and external market collaborative effort. Again, this conclusion is reflected in the perspective of the CEO, who stated unequivocally that:

> "Unless it [technology transfer] is fully collaborative it will not work."

The data suggests that, from the firm's perspective, promoting technology transfer involved 'marketing' the technological knowledge that had been built overtime by the marketing and commercial functions. The firm was also promoting network relationships between the technical and marketing functions, and with external customers and networks. The firm's approach to technology transfer is illustrated in Figure 5-5.

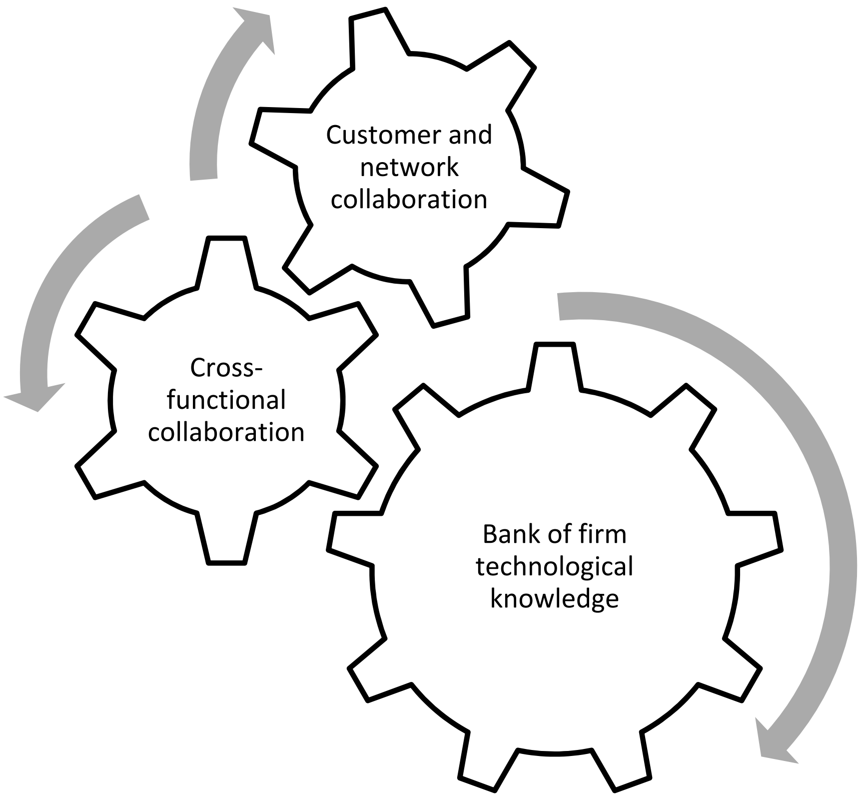

Figure 5-5: Case D Technology Transfer: the firm perspective

5.52 The Actor's Perspective

Of interest to the study was how the technology strategy articulated by the firm's executive was reflected in the activities of the actor's in the research setting. Since firm technology transfer effort was focused on developing and commercialising the firm's 'bank' of technological knowledge then, perceptibly, collaborative effort would be required to focus this knowledge on identifying opportunities for its deployment in (new) markets and networks. Furthermore, collaborative effort would be required to develop value propositions that met precise technical and commercial needs in these markets.

Arguably, a difficulty facing the firm concerned the ability of the technical and marketing functions to bring together detailed customer knowledge (market intelligence), and then match these needs with the firm's technological knowledge. Furthermore, the new strategy brought with it significant new challenges for the firm's technology transfer and commercialisation effort. This is reflected in the comments of the senior marketer, who stated:

> "So it's just not good enough to be doing any good science, you actually have to be getting some of these things to the point where you're getting a commercialised outcome or at least having it evaluated and considered."

5.52.1 Technology Innovation

The ability to recognise which ideas from existing technical 'knowledge' had the potential to become innovative technologies that had market application was proving a challenge for *Case D*. Advancing innovative ideas beyond proof of technical capability and into external markets requires detailed knowledge of customer and network technological needs. Without this ‘market knowledge’, the danger was that innovative ideas (and ultimately technical development) would take on a life of their own (escalation bias), being driven by internal technical considerations as opposed to meeting the needs of customers. If this was the case, then valuable resources would be consumed and chances for technology transfer would be diminished. These challenges for innovation are reflected in comments made by the senior marketer, who stated:

> “One of the things that we are constantly sort of, there’s a grey area, is when is a good science idea still needing to be nurtured... and clearly needs to be nurtured as part of a research programme as opposed to it’s now ready to really be stripped out and pushed hard into a commercialising sort of framework and we...that cut-off point isn’t always as obvious”,

and further that:

> “We are getting away from what traditionally used to be stuff very strongly siloed and you never had a clue what was going on in the lab”.

Significantly, the idea that marketing should be involved early in the innovation process to ensure that technology developments reflected an understanding of network or customer needs was described as being a key consideration. In this regard, the senior marketer stated:

> "...the earlier we get to think about these things the earlier you've got a chance to actually work out what is the best route you can possibly do this with because it may well be that at a very early stage we might say well gee, that's actually something that we maybe should go and talk to industry because they've got something over here and by putting those two things together, we might get a better outcome."

Thus, an important aspect of *Case D* innovation effort was securing marketing involvement in the early 'proof of concept stage' so that commercial potential could be identified. The difficulty here was that innovative ideas would only develop commercial potential if there was a clear understanding by the technical team of the 'problem' (or opportunity) facing the customer, and more particularly, how the innovation might bring commercial benefit to the customer. Furthermore, without this 'market knowledge', there was a danger that technologies in development would 'die in the valley of death', and in the process, waste valuable resources. The senior marketer reinforced this need for market knowledge by stating:

> "Yeah the ([technical] guys get a bit de-motivated when they, you know, well I can't do that, you know, but it's not because it's a bad idea, it's just that we don't have enough information on that in time to make the call."

Similarly, another of the firm's marketer's suggested that getting the scientists to engage with the marketing function would always be a difficult proposition because "it [marketing] could mean a hundred different things to a hundred different people".

Despite these challenges, there was acknowledgement by the science and commercial functions that working collaboratively on developing innovative technical solutions would provide the firm with technological knowledge 'resources' that, because they were linked to specific customer needs, would enhance the firm's potential to transfer technology products and services. Reinforcing the need for cross-functional collaboration, the senior marketer stated that:

> "It's a whole host of things but all of which sort of gel together and give you if you like that intangible mix that you need to, and you know it's sort of working, so you're like we'll see the commercialisation team manager or the technology platform manager and a couple of scientists in our office...I know hey, this is working because these people are now coming to talk to us about an idea, you know, which never would have happened in the past. It just wouldn't have been like that."

5.52.2 Technology Development

The raw data revealed that another challenge for *Case D* technology transfer concerned the ability of the scientists to accept that it was no longer their sole duty to get the firm's technologies developed and transferred into the market, and that the marketing function was an intrinsic part of that process. This assertion is illustrated by one of the firm's marketer's, who stated that:

> "One of the challenges is getting some of the science people to accept that it's no longer their duty per se, that there are other people now who are going to make a difference to this and the

> reality is that as the importance of the development of the product, what it's going to look like, the shape, design ...and so therefore you're dealing with a totally different set of needs and that, so we've got a different set of people that are actually capable of handling that and dealing with that. So we are generally, I've generally found so long as you're running that in a team environment and managing that, it works okay."

Similarly, the raw data suggests that marketer's have a role in 'coordinating' the technical relationship between the firm and potential industry customers. In this context, marketing's role involves promoting customer involvement in the actual technology development phase, thereby ensuring that product attributes are developed and customer needs are met. This concept, that marketing can facilitate technical relationships with customer networks, is reflected in the comments of a marketer, who stated:

> "But I think if you can, and this comes back to my earlier comment that if you can get commercialisation partners involved early in the development of your research programme where you've got a clearly mapped out commercialisation objective then you're achieving that and they're adding quite a bit of value to the thinking, not so much of the technical but in terms of the things they've got to think about as they start to think about the market bit of it. But again I think that you do have to have an element of management around that, and that's often done with the business development managers who are coordinating that as well because there's a strong link between the client and the science...it's actually is the coordinating link".

5.52.3 Technology Transfer

A key platform for *Case D* technology transfer strategy concerned the development of a 'bank' of technological knowledge that brought together technical know-how and market intelligence with an intention to match this knowledge to precise customer and market needs. However, understanding customer technical needs (and opportunities) and then matching the firm's technical capabilities to these needs presupposes that the firm is in possession of external relationships, and further that these relationships facilitate the collaborative exchange of technical and commercial knowledge. Here, the firm's relationships can be seen as 'resources' for technology transfer effort, and the ability of the firm to develop and grow a network of industry relationships can thus be viewed as key resources for the transfer and commercialisation of the firm's technology products and services. Supporting this concept, one science respondent stated that:

> "It's one of the strong drivers that I would suggest to you is networking and yeah, I think that's a key part of it and if you're not networking and if you're not mixing in that all the time and seeing off that then you are probably not going to be as well connected. But at the same time we scientists should generally have some sort of sense, I mean I took one technology platform this morning and went to a breakfast session with an industry speaker and he got talking afterwards and the guy said oh, you know, we've got this particular problem and [name] says well in actual fact we might be able to help you with that problem. Now if he hadn't gone to that meeting he wouldn't have come across that, so now there's a meeting going to be organised to have a session as to whether in actual fact what they think is their

> problem well we might actually have a solution for, so that came out of a networking opportunity".

5.52.4 Technology Diffusion

As with other firms in the CRI C*ase*, 'after sale' engagement with the customer to ensure that the promised technology benefits were delivered, and that innovation effort continued, were not phenomena that were observed or were evidenced in *Case D* data. It is contended that a lack of diffusion effort reduces the ability of the firm to innovate and transfer technology products and services because, without post-sale engagement, there is a risk that technology's attributes are not realised and commercial gains do not accrue to the customer. As a consequence, lack of firm diffusion effort can have a damaging effect on the business-to-business relationship, reducing the opportunity for collaborative effort, and likely creating openings for competing technology products and services.

The point here is that the successful diffusion of new technology products and services into the customer's business enhances the development of inter-firm relationships that, taken as a whole, provide technological knowledge resources that allow the customer to 'capture' the benefits of acquired technology products and services while promoting ongoing and collaborative engagement with the firm to develop further technology innovations. As could be expected, the difficulty facing *Case D* diffusion effort involved the need to ‘market’ the firm’s technological knowledge *across and between* the firm and its customers so that technology benefits could be accrued and collaborative innovation could continue. The senior marketer described this challenge for firm marketing effort by stating:

> “It’s a huge amount of information but you’re trying to get it in a way that other people can access it and learn from it and develop from it and we’re just trying to get our mind around a more structured way of doing that.”

Table 5-13 summarises the occurrences of phenomena, concepts, and categories that emerged during thematic analysis of *Case D* raw data.

Technology Transfer Phenomena	**Total**	**Science**	**Market**	**Concepts**	**Categories**
Resources	1	0	1		
Funding	29	8	21	Funding technology transfer	Resources
Prioritisation	0	0	0		
Compete for resources	0	0	0		
Ideas	22	10	12		
Knowledge	11	2	9		
Intellectual property	11	0	11	Innovation	
Technical knowledge	20	8	12		
Market intelligence	1	0	1		
Information	11	1	10	Technical knowledge	Technological - knowledge
Technology	70	10	60		
Innovation	26	8	18		
Technology development	28	7	21		
Technology transfer	1	0	1		
Technical attributes	3	0	3	Technology development	
Science	89	20	69		
Technical capability	5	1	4		
Joint Ventures	1	0			
Relationship	7	0	7		
Team	18	6	12		
Partnerships	17	1	16	Collaboration	
Trust	1	0	1		Relationships
Cross-functionality	14	0	14		
Skills	2	0	2	Partnerships	
Culture	2	1	1		
Connection	26	1	25	Cooperation	
Communication	1	0	1		
Consumer	0	0	0		
External market	57	9	48		
Internal market	6	0	6	Market Networks	
Customer	12	1	11		Internal marketing
Network	10	1	9	External market	
Value chain	2	0	2		
Marketing	11	4	7	Internal market	
Change	16	10	6		External marketing
Value proposition	2	0	2	Technology transfer / commercialisation	
Value	25	5	20		
Commercialisation	48	12	36		
Sell	6	0	6		
Product	35	3	32		

Table 5-13: Summary of Case D Interview Data

Chapter 6 - ACROSS-CASE ANALYSIS AND FINDINGS

Technology is so much fun but we can drown in our technology. The fog of information can drive out knowledge - Daniel J. Boorstin

Introduction

The objective of Chapter Six is to utilise the technique of pattern matching to illuminate marketing involvement in technology transfer *across* the research setting. In this mode of analysis, empirical patterns are compared with the concepts and categories developed in Chapter Five in order to test for literal replication. The identification of *phenomenological patterns*, particularly when compared with literature themes, strengthens the case for analytical generalisation *and* reliability of the study (Miles et al., 1994; Yin, 1994).

6.1 Across-Case Analysis Strategy

Where Chapter Five triangulated the raw data with observed phenomena, and with firm documentation, facilitating the development of concepts and categories pertaining to technology transfer, Chapter Six builds on the analysis by focussing on patterns of marketing phenomena occurring across the *Case* during technology transfer effort. This strategy, supported by the author's reflexive position, enables the study to further theorise marketing's role and meet a key objective, namely, the development of managerial insights for marketing's 'role' in firm technology transfer effort.

6.11 Theoretical and Practical Underpinnings

As a precursor to illuminating marketing patterns emerging from the raw data, analysis across the *Case* begins by presenting the themes and patterns emerging from contemporary marketing theory and practice identified in Chapter Two[31]. The proposition here is that, by comparing marketing patterns from theory and practice with marketing patterns emerging from the raw data, a role for marketing in firm technology transfer effort can be induced. To this end, Table 6-1 presents marketing patterns from theory and practice.

Themes in Technology Management Theory	Themes in Industrial Marketing Theory	Marketing Practitioner Themes in New Economy Technology Transfer	Marketing Patterns in Theory and Practice
Market linked innovation activity is the precursor to technology development and transfer	Distinction between internal and external markets, and conceptual development of marketing as a service	Technology transfer involves determining and meeting internal and external customer needs	Technology transfer involves technological (marketing and technical) knowledge
Technical knowledge leads to technology products and services which are sources of firm value and competitive advantage	Developing the firm's marketing capability, specialised knowledge and skills, and involves new practices and approaches	Competing in the new economy involves capturing and marketing the firm's technical knowledge and capabilities	
Cross-functional relationships promote firm innovation activity technological knowledge	Marketing involves social interaction and inter-dependencies	Collaborative activity between the technical and marketing functions enhances technology innovation and transfer	Technology transfer involves intra and inter-firm
Partnerships and cooperative	Firm value can be co-created with internal	Firm marketing involves developing	

[31] Refer Figure 2-13

relationships promote firm technology transfer	and external customers	internal and external customer and network relationships	relationships
Market connectivity in technical development promotes firm technology transfer	'Markets' can be characterised as individuals, groups, and networks	Inter-connected markets and technology products and services have changed the competitive landscape	
Early 'kill' decisions conserve technical development resources	Resources for marketing are heterogeneous and imperfectly mobile	Market and network intelligence promotes firm technology innovation and transfer	Technology transfer involves marketing and technical resources

Table 6-1: Marketing Patterns in Theory and Practice

As can be seen in Table 6-1, comparative analysis of the themes from technology management theory, marketing theory, and marketing practice reveal that marketing involvement in firm technology transfer reflects three distinct patterns:

Theory and practice pattern 1: Technological knowledge

Theory and practice pattern 2: Inter and intra-firm relationships

Theory and practice pattern 3: Marketing and technical resources.

In order to more fully analyse these patterns from theory and practice with those contained in the raw data, each pattern, and its relationship to marketing involvement in technology transfer, is now discussed.

Firstly, it is concluded that promoting technology transfer involves deployment of firm technological knowledge, itself a combination of technical knowledge (i.e.

technical innovation and proof of concept) and marketing knowledge (i.e. market intelligence and customer relationships). In practice, technical development without market 'connectivity' reduces the ability of the firm to effect technology transfer and commercialisation. Similarly, market engagement without knowledge of firm technical capabilities, and their potential to solve customer problems, reduces firm technology transfer potential. Put simply, technology developments are, *in theory and practice*, more likely to be transferred and commercialised where technical attributes are matched to specific customer needs.

Secondly, firm technology transfer, by its very nature, involves intra *and* inter-firm relationships. In this context, *intra*-firm relationships are characterised as cross-functional collaborative effort between the marketing and technical functions. Such relationships allow the transfer of technological knowledge so that technical teams become aware of explicit market needs, promoting the informed development of technology products and services with attributes that meet these needs. Similarly, *intra*-firm relationships allow the marketing function to become explicitly aware of the firm's technical capabilities and innovation potential, facilitating the marketing of these capabilities to customers and networks who, in theory, stand to benefit from this knowledge.

In practice, cooperative relationships between marketers and technical teams conserve technical resources by increasing technology up-take as a consequence of targeted technical development. Similarly, such cooperative relationships decrease competitive pressure through active (read: motivated) involvement of the technical team during customer engagement and value proposition development, promoting heterogeneous technical solutions not easily matched by competing technology products.

By comparison, *inter*-firm relationships are characterised as business-to-business relationships whose purpose is joint exploration of the commercial potential in transferring and diffusing technology products, services, and knowledge. In this context, it is concluded that technology transfer potential is enhanced where collaborative effort between firms promotes the exchange of technological knowledge, serving as a precursor to innovative activity and the development and transfer of technology products and services. In practice, these relationships often involve a joint commitment to resourcing technology development, generating a shared understanding of the development needs and value benefits that accrue to both parties – the value proposition. Thus, effective *inter*-firm 'relationships' provide opportunities for marketer's to gather accurate and insightful market intelligence, with explicit knowledge of customer 'problems and opportunities' providing a pathway for technical team innovation effort.

Thirdly, it is concluded that firm technology transfer effort involves a heterogeneous combination of marketing and technical resources. In this context, resources are deployed for technical team innovative effort, proof of concept development, and ultimately, for technology product and service development. For marketer's, resources are deployed for gathering market and customer intelligence, customer and network relationship development, and for *inter*-firm collaborative effort. In practice, marketing resources are deployed in transferring marketing knowledge to the internal market (i.e. gathering and dissemination of in-market intelligence to influence technical development), and to the external market through the establishment and facilitation of collaborative and partnership arrangements, and the facilitation of *inter*-firm exchanges of technological knowledge.

6.2 Marketing Patterns across the Case

To strengthen the case for analytical rigor, the analysis now turns to illuminating marketing patterns *across the Case*, and then to establishing whether these patterns are reflected in the concepts and categories developed in Chapter Five[32], *and* in the patterns developed from theory and practice identified in Table 6-1. The proposition here is that by comparing patterns in *Case* phenomena with themes and patterns in theory and practice, it is possible to claim analytical

[32] Refer Case firm Data Summaries.

generalisation and reliability, allowing theoretical development of marketing's role in a way that reflects its involvement in the new economy environment. Importantly, it also allows the study to address the gap between theory and practice.

6.21 Firm-level Document Themes

The across-*Case* analysis began with the compilation and comparison of themes from *Case* firm documents and reports. As identified in Table 6-2, firm level themes relating to the technology transfer intent of each *Case* firm were compared and contrasted to determine the existence of empirical patterns. Significantly, a pattern emerged across this data set, with *Case* firm documents all revealing plans to promote firm technology transfer potential through the development and deployment of:

Documentation pattern 1: Internal relationships (cross-functional cooperation)

Documentation pattern 2: External relationships (collaborations and partnerships)

Documentation pattern 3: Technological knowledge (technical and marketing) resources

The analysis process then compared these document patterns with marketing themes that emerged from the raw data. As can be seen in Table 6-2, the marketing themes substantially reflected the strategic intent of each *Case* firm to promote innovation and technology transfer through cross-functional cooperation, external partnership arrangements, and through the development of technical and market knowledge. The marketing themes and their relationship to firm-level themes and patterns are now discussed more fully.

6.22 Marketing Themes and Patterns in the Raw Data

Determining marketing themes and patterns in the raw data from across the *Case* required cross-examination of transcription references to 'marketing effort' using, as a guide, (i) the interview questions, (ii) the Summary Tables of *Case* interview data, and (iii) the author's reflexive position. This process resulted in the identification of marketing themes from science and marketing respondents across the research setting. Analysis of these themes (Table 6-2) revealed a pattern of 'relationships', 'knowledge' and 'resources', which are found to be consistent with the marketing patterns found in theory and practice (Table 6-1).

Furthermore, when comparing the patterns from *Case* documentation with the marketing themes and patterns contained in the raw data, the researcher concluded that with one exception, each of the themes were explained by the document patterns. The inference here is that from both the firm *and* actor perspectives', the pattern of internal relationships, external relationships, and technological knowledge empirically reflect marketing resources in firm technology transfer effort.

For example, the data points to the importance of market intelligence, which when combined with firm technical ability, generates *technological knowledge* that can be applied to developing technical attributes that meet customer and network needs. In this instance, the data suggests that combining market and technical knowledge promotes internal team work through *cross-functional cooperative relationships*, and increases the firm's potential to innovate, develop, and transfer technology products and services. Similarly, the cross-*Case* intent of each firm to develop *external market relationships* was seen as a way to facilitate involvement in *cooperative technical relationships and partnerships*, with data themes and patterns reflecting actor intent to promote technical innovation and technology transfer through collaborative relationships.

The 'exceptional' or sub-theme noted above is important to the study because it relates to the challenge for marketing (or marketing challenge) raised in Chapter One, and underpins a focus of the study. The proposition that the marketing concept and the practice of marketing continues to be misunderstood emerged as a significant theme in the raw data. Here, interviewees expressed their misunderstanding and mistrust of marketing and the marketing function, with respondents across the *Case* uniformly describing confusion as to marketing's role in technical innovation and technology transfer activities. Indeed, many respondents viewed the marketing function as having the propensity to detract from scientific and technical discovery by consuming firm resources that could otherwise be deployed in science effort, or alternatively were unsure how best to develop and deploy marketing resources that relied more on collaborative relationships and knowledge exchange, and less on concepts associated with the 4Ps. This finding reinforces practitioner experience, and confirms the intent of the study to re-evaluate marketing's role in technology transfer - from the perspective of marketing - in order to develop practical insights for industrial firm marketing management. The concept of an 'evolved' role for marketing, one that reflects marketing phenomena in the new economy environment, is discussed in Chapter Seven.

	Firm-level Themes in Case Technology Transfer Documents	**Marketing Themes from the Interview Data**	**Phenomenological Patterns**
Case A:	1. Developing external relationships 2. Promoting cross - functional cooperation 3. Transferring technological knowledge	1. Market intelligence connects technical innovation with customer needs 2. Marketing relationship development with external customers and networks promotes technology innovation and commercialisation potential 3. Internal collaborative relationships and the exchange of information and between the marketing and technical functions promotes firm innovation and technology transfer potential 4. Marketing knowledge combined with technical knowledge enhances firm technology innovation and transfer 5. Marketing resources are	Market intelligence Technical innovation Cross-functional relationships and collaborative effort External customer and network relationships Technological knowledge Marketing and technical resources Marketing misunderstood

	Firm-level Themes in Case Technology Transfer Documents	Marketing Themes from the Interview Data	Phenomenological Patterns
		required for engagement with external customers and market networks, and for intelligence gathering and dissemination to internal customers 6. Marketing capability is a resource for firm technology transfer 7. Marketers and scientists both perceive benefits in cross-functional engagement 8. Marketing is misunderstood and mistrusted by technical teams	
Case B:	1. Provision of marketing and technical resources 2. Cross- functional teamwork 3. Industry partnerships	1. Market intelligence can inform innovation and technology transfer effort 2. Marketers can assist with identifying and directing innovation objectives 3. Marketers can identify customer problems and opportunities 4. Marketers can 'bundle' technological knowledge for external markets 5. Marketers can establish opportunities for new external cooperative and technical partnership relationships 6. Marketing and technical teamwork enhances firm innovation and technology transfer potential 7. Marketing relationship resources are necessary for enhancing firm innovation and technology transfer effort 8. Marketing is misunderstood and mistrusted by technical teams	Market intelligence Technical innovation Cross-functional relationships and collaborative effort External customer cooperative relationships Marketing and Technical resources Marketing misunderstood

	Firm-level Themes in Case Technology Transfer Documents	Marketing Themes from the Interview Data	Phenomenological Patterns
Case C:	1. Alignment of science and marketing objectives 2. External network relationships 3. Cross-functional cooperation	1. Innovation activity is dependent on marketing and technical cooperation 2. Marketers can ensure that technology attributes are linked to market needs 3. Market intelligence can recognise the value to customers of technical knowledge and capability 4. Deploying marketing resources can promote firm technical capability and market connectivity 5. Marketing can identify new network opportunities 6. Marketing can conserve technical resources by determining which technical development has the higher chance of commercial success 7. Marketers can create value from IP 8. Marketing can develop firm relational resources 9. Marketing cooperation with technical teams promotes development of firm technological knowledge 10. The practice and benefits of marketing is unclear to technical teams	Cross-functional relationships and collaborative effort Market intelligence Marketing and technical resources Technological knowledge Internal market relationships External customer and network relationships Marketing misunderstood
Case D:	1. Determination of technological knowledge resources 2. Cross-functional collaboration 3. Customer and network collaboration	1. Marketing can convert technical ability into technological knowledge 2. Marketing can determine which innovations and proof of concepts have market potential 3. Marketing relationships can gain access to sensitive customer operational and commercial data and influence technology	Technological knowledge Cross-functional relationships and collaborative effort External customer and network relationships

	Firm-level Themes in Case Technology Transfer Documents	Marketing Themes from the Interview Data	Phenomenological Patterns
		development 4. Relationship marketing can promote technology diffusion and continued inter-firm cooperation 5. Marketing can coordinate Internal and external relationships 6. Marketing is misunderstood	Marketing misunderstood

Table 6-2: Marketing Themes and Patterns across the CRI Case

6.23 Comparing Case Marketing Patterns with Concepts and Categories

The analysis now considers whether the marketing themes and patterns occurring across the *Case* reflect the concepts and categories detailed in Chapter Five's *within Case* analysis. Table 6-3 presents the collated concepts and categories, and compares them with marketing patterns from across the *Case*.

Case Technology Transfer		
Within-Case Concepts	**Within-Case Categories**	**Across-Case Marketing Themes and Patterns**
Firm resources Technical resources Marketing resources	Resources	• Marketing and technical resources
Technical knowledge Technical innovation Technology transfer Market intelligence	Technological knowledge	• Technological knowledge from technical capability and market intelligence
Collaboration Partnerships Cooperation	Relationships	• Internal cross-functional relationships and collaborative effort • External customer and network relationships and collaborative effort
Market networks Internal market External market Value proposition Technology transfer/ commercialisation	Internal market External market	

Table 6-3: Comparative Analysis of Concepts, Categories and Patterns

The conclusion here is that concepts and categories from the within-*Case* analysis reflect the marketing patterns identified across the *Case*, suggesting analytical ge neralisation and reliability of the findings. A further conclusion is that marketing's role in firm technology transfer effort shows patterns of relational engagement and collaborative involvement with internal and external customers and networks. Inductively, this suggests that collaborative relationships facilitate the development and transfer of firm technological knowledge, and are thus critical resources in firm technology transfer effort.

Notwithstanding this finding, an important question here concerns the comparative analysis of marketing patterns from the *Case* with those from theory and practice, and if the patterns 'match', how a theoretical role for marketing could be inferred from this 'meta-pattern'.

6.24 Comparing Case Marketing Patterns with Theory and Practice

Table 6-4 compares marketing patterns from the *Case*, with marketing patterns in theory and practice. The conclusion here is that patterns for marketing effort in firm technology transfer are consistent across the empirical data, in theory, and in practice. Given the objectives of the study, this is an important finding because it illuminates new considerations for marketing's practical role in firm technology transfer effort, and indeed highlights the need for theoretical engagement with concepts more closely associated with the contemporary marketing environment. The implications of these findings for practice and theory are discussed more fully in Chapter Seven.

Case Marketing Patterns	**Meta-Patterns**	**Marketing Patterns in Theory and Practice**
• Internal market relationships and cross-functional cooperation • External market customer and network relationships, collaborations, and partnerships • Technological knowledge from technical capability and marketing intelligence • Technical innovation though marketing relationships and cooperation	• Inter-firm relationships • Intra-firm relationships • Collaboration, cooperation and partnerships • Transfer of firm technological knowledge	• Technology transfer involves technological (marketing and technical) knowledge • Technology transfer involves intra and inter-firm relationships • Technology transfer involves marketing and technical resources

Table 6-4: Meta-patterns in Marketing

6.25 Summary and Conclusions

Analysis of marketing patterns within and across the Case, *and* in theory and practice, reveal overarching or ‘meta-patterns’ for marketing involvement in firm technology transfer effort, and further that these patterns illuminate and describe the nature of marketing’s role. In essence, these ‘meta-patterns’ suggests that marketing’s role involves:

1. The deployment of marketing resources to capture and transfer firm technological knowledge. These heterogeneous resources are described as a combination of ‘market intelligence’, co-operative ‘relationships’, and

'technical capability', which when taken together, provide the firm with an ability to innovate and connect technical development to precise customer and market needs;

2. The deployment of marketing resources to develop *internal* market cross-functional cooperative relationships. These heterogeneous resources are described as 'cooperative internal relationships' and 'team work' between the marketing and technical functions, which when deployed, facilitate firm technological knowledge, and inform innovation activity, technical development, and technology transfer;
3. The deployment of marketing resources to develop *external* market collaborative relationships. These heterogeneous resources are described as 'collaborations' and 'cooperation', between the firm and its customers, which when deployed, facilitate the gathering of explicit market intelligence, technical innovation, collaborative technical development, and technology transfer.

Chapter 7 – DISCUSSION

You can't wait for inspiration. You have to go after it with a club - Jack London

Introduction

The purpose of Chapter Seven is to discuss and interpret the study's key findings and to explore their implication for theory, practice, and policy development. After restating the research objectives, the Chapter begins with a review of the key findings and discusses their significance for marketing and for firm technology transfer effort. The second section then interprets these findings and develops a theoretical role for marketing in each phase of firm technology transfer. This section concludes with the presentation of a new conceptual framework for industrial marketing that is informed by the empirical data, marketing theory, and practitioner experience, and as such, has application in theory and practice. The third section uses the new conceptual framework to frame recommendations for further marketing theory development, taking account of the marketing environment and new and evolving concepts in marketing theory. The Chapter concludes with a discussion of policy implications for the MoRST and the New Zealand Science system.

Research Objectives Restated

The study set out to explore industrial marketing in the contemporary business environment. The primary goal was exploration and description of marketing's theoretical role in firm technology transfer effort so that marketing theory, and its practical application, could be developed. The study asked the question: 'what are the roles that marketing plays in industrial firm technology transfer effort'?

7.1 Section One: Key Findings

7.12 Finding One: Meta-patterns in Industrial Marketing

The overarching finding of the study relates to the identification of themes and patterns in the *Case* data, in marketing theory, and in marketing practice, that illuminate 'meta-patterns' that describe a role for marketing in firm technology transfer effort.

In particular, these 'meta-patterns' relate to the deployment of marketing resources that promote firm technology innovation, development, and transfer through:

1. Inter-firm and intra-firm relationships
2. Collaboration, cooperation, and partnerships
3. Firm technological knowledge

This finding is significant because it lays the way open to re-examine the efficacy of the traditional (4Ps) theory of marketing which, at its core, reflects continued reliance on concepts that are out of step with the study's empirical findings, contemporary marketing theory, and contemporary marketing practice. This is not to say however, that the concepts embodied by the 4Ps are redundant, rather, that their practical application in a knowledge economy setting does not reflect the importance to industrial marketers of relationships, collaboration, and the development and transfer of firm technological knowledge. For example, the 'product' concept no longer reflects the intangible nature of inter-firm collaborative technology development, or the application of jointly developed intellectual property and technological knowledge. The concept of 'price' does not reflect collaborative technology development, non-uniform market application of technology product attributes, or indeed the shared ownership of cooperatively developed technical capabilities. Equally, the concept of 'promotion' now reflects instantaneous global presentation of the firm's market offer via interactive web sites and the internet as opposed to trade shows and advertising. Lastly, the concept of 'place' has lost its relevance. Innovative technology products and services now have the potential for application in non traditional sectors with non-traditional customers and networks, bringing almost limitless geographic placement of the firm and its market offer. From the industrial firm perspective, this suggests that the role of marketing needs to move beyond the theoretical strictures of 4Ps marketing thinking, and embrace new marketing concepts more suited to firm value creation in an interconnected knowledge driven economy.

The point here is that the role for marketers in the new economy has become one of managing a network of cooperative internal relationships among people and functional units which form the basis of the firm's ability to innovate, develop, and transfer technology and technology products. It has also become one of managing a complex network of collaborative external relationships that facilitate and implement value in the form of technological knowledge, technology products and services, and money. The role for marketing in firm technology transfer has thus become one of assessing, developing, and using the firm's internal and external relational resources to cooperatively and collaboratively develop and transfer technological knowledge and technology products and services.

7.13 Finding Two: An Expanded Role for Marketing in Firm Technology Transfer Effort

The study found that marketing's role in firm technology transfer effort encompasses the promotion of ideas capture and innovation activity, technical development, and technology transfer and commercialisation, reinforcing the applicability of the conceptual framework of technology transfer postulated in Figure 2-9. While the concept of technology 'diffusion' is not explicitly reflected in the empirical data, technology theory and practice suggest that deployment of marketing resources (i.e. ongoing customer relationships and market intelligence) promote firm ‘diffusion’ activity, further illuminating a role for marketing in this phase of technology transfer.

Significantly, the raw data suggests that scientists and technical teams see a need for increasing *their* engagement with marketers, customers, and market networks so as to better inform technical development and technology transfer. The data also suggests that cooperative marketing relationships with technical teams facilitates development and transfer of firm technological knowledge, innovation, and technology development and transfer. The conclusion here is that marketing is well placed to facilitate and promote firm ideas capture and innovation activity, particularly since this activity underpins the development of future products and services that will ultimately be marketed by the firm. Marketing is also well placed to influence firm technology development and transfer given that development of technical attributes that are market connected promote competitive market advantage, and increase the potential for technology transfer and commercialisation. In this context, the technology transfer difficulties experienced in the *Case* reflect a lack of cross-functional cooperation and inter-firm relationship development, whereas functional cooperation during the technology innovation and development phase promotes development of heterogeneous technological knowledge. This knowledge is a vital marketing resource for technology value proposition development, and serves as a precursor to inter-firm relationship development, collaborative technical development, and technology transfer.

7.14 Finding Three: Marketing: Still Mistrusted and Misunderstood

Consistent with theory and practice, the study found that the marketing concept and marketing practice continue to be misunderstood. However, while the empirical data suggests 'confusion' with marketing's *conceptual* role and its practical application, no such confusion exists in the *Case* with respect to the need for deploying marketing resources to promote collaborative inter and intra-firm relationships and firm technological knowledge.

The findings also suggest that, in a business environment that values innovation and technology transfer, cross-functional cooperative effort to effect the matching of market intelligence and external relationships with firm technical capability will increase the direct exposure of marketing thinking (understanding and meeting customer needs) to a wider audience within the internal market. In a sense, 'new economy marketing' facilitates the 'marketing of marketing' to other functional groups, further highlighting the importance of internal and external market network relationships.

7.15 Finding Four: The Importance of Internal Market Relationships for Firm Technology Transfer

There is a saying in marketing that for the firm to achieve its external market objectives, the firm's internal market must *first* function. The study, and the literature, reinforces this view by confirming the importance of the internal market for firm technology transfer. Without internal market collaborative relationships, firm innovation activity and the development and transfer of valuable technological knowledge (market intelligence) will be curtailed. So too, will the ability of the firm to match its technical capability to market needs, further reducing firm technology transfer and commercial potential.

The discussion here relates to the need for the marketing function to embrace an 'interactive parallel' when managing the internal and external markets. Put simply, marketing's role has become one of facilitating and managing multiple internal relationships to promote technology innovation and development - while at the same time managing multiple external relationships to promote technology transfer and commercialisation. Again, the study's conceptual framework of technology transfer reveals that half of firm technology transfer effort occurs within the internal market, making 'internal market development' a vital consideration (role) for marketing effort.

7.2 Section Two: Interpreting a Role for Marketing in Industrial Firm Technology Transfer Effort

7.21 Marketing's Role in Technology Innovation

In the *Case*, innovation activity is undertaken to provide the firm with future technology product and service potentials, and ultimately, with revenue streams from technology transfer and commercialisation. This makes ideas capture and innovation activity of vital concern to marketers, since marketing will be charged with promoting and commercialising the firm's future technology product and service offer.

However, even if issues of cross-functional 'mistrust' are overcome, firm marketing effort faces challenges in capturing potentially disparate innovative technical ideas from formal R&D effort, and also from more informal 'skunk works' projects associated with individuals or smaller technical teams. The discussion here relates to a need (role) to deploy marketing resources to promote firm ideas capture and technology innovation effort so that:

1. Intellectual property and/or intellectual capital potentials are identified
2. Future technology product and service potentials are identified
3. Customer and network (commercial) potentials are explored
4. Opportunities for collaborative relationships with external customers are initiated

5. Bundling and packaging with other technical capabilities take place
6. Cooperative internal relationships are developed (and issues of trust dispelled)
7. Firm technological knowledge is developed

7.22 Marketing's Role in Technology Development

Consistent with theory, difficulty during the technology development phase (valley of death) was uniformly reported in the *Case*, in particular technical team uncertainty that development resources were secure, and marketing uncertainty that technology developments were 'market connected'. The suggestion here is that in mitigating these uncertainties, marketing's role involves early deployment of marketing resources (i.e. market intelligence and customer relationships) to promote market-connected technical development and technology transfer potential. This is an important role given that technology management theory reports the criticality of market connectivity in technology development, and the importance of conserving technical resources through *early* termination decisions. Thus in a practical sense, marketing's role involves deploying marketing resources to promote firm technology development so that:

1. Technical development effort is informed by market intelligence
2. New technology products and services potentials are identified, and new technical capabilities are promoted,

3. Collaborative external market technical development opportunities are identified
4. Market intelligence is applied to firm decisions on resource allocation
5. Cooperative internal relationships and cross-functional networks are developed
6. Firm technological knowledge is developed.

7.23 Marketing's Role in Technology Transfer

A tenet of this study is that conceptual application of marketing's 4Ps does not provide an adequate guide for marketing's role in firm technology transfer. Moreover, practice and theory both associate technology transfer and commercialisation with very high levels of uncertainty, unpredictable demand patterns, and increasing competitive pressure, making technology transfer extremely problematic for marketing managers.

In order to mitigate these 'technical' and 'market' uncertainties, the argument is that a more holistic role for marketing is needed to better promote the technical and market objectives of the firm. Where in the past it was reasonable to expect that technology would be transferred simply because the firm had developed a technology 'product' that met a *supposed* market need, formulated a 'price' acceptable to the customer, supported sales effort through trade 'promotion' activities, and pursued customers at their 'place'. Now, by contrast, analysis of the empirical data, theory, and practice contend that marketing's role involves the development of cross-functional technological knowledge and collaborative external relationships. Conceptually, this is a more expansive approach, and involves deploying marketing resources to promote firm technology transfer and commercialisation so that:

1. Technology value propositions are informed by firm technical capability, market intelligence, and external customer relationships (i.e. technological knowledge)
2. Collaborative external market technical developments are linked to explicit customer needs, increasing the chance of commercialisation and competitive advantage
3. Firm intellectual property, intellectual capital, and technical capabilities are better able to be 'valued' and commercialised as a consequence of network relationships and market intelligence
4. Technology product and service branding and promotional opportunities are illuminated.

7.24 Marketing's Role in Technology Diffusion

While diffusion activity was not explicitly reported in the empirical data, it could be argued that the concept - i.e. continued engagement with the customer to ensure capture of customer technology benefits - now finds practical expression in ongoing collaborative external relationships that, by their nature, facilitate ongoing technical collaboration and value capture for the firm *and* the customer. In this sense, technology transfer (commercialisation) and diffusion (after sales) activities are subsumed by ongoing inter-firm relationships and collaboration. Furthermore, these relationships enable ongoing capture of explicit market intelligence in the form of explicit knowledge of customer and network needs, creating marketing opportunities for further technical collaboration and technology transfer.

Theory and practice also suggest that firm 'diffusion' effort is encapsulated by activities associated with technology transfer, suggesting that collaborative technical development create the conditions for ongoing relationship with the customer, illuminating a role for marketing in this phase. Notwithstanding the conceptual merging of firm technology transfer and diffusion effort, marketing resources are deployed after technology commercialisation so that:

1. Ongoing collaborative effort continues and new opportunities for technology innovation and transfer are identified
2. Market intelligence continues to inform firm technical development
3. Firm technological knowledge continues to develop.

7.25 Summary

Fundamentally, this thesis argues that marketing's role in firm technology transfer is unclear in practice and in theory, with this confusion reflected in the empirical data. Further, the study contends that normative application of marketing's 4Ps in a new economy environment does not adequately describe marketing's role in firm technology transfer effort. This is a problem for industrial marketing managers seeking to increase firm revenue and gain competitive advantage.

Using the conceptual framework of technology transfer developed in Chapter Two (Figure 2-9), the study found that marketing's theoretical role, and its practical application, involves concepts associated with the internal market (innovation and technical development, cross-functional relationships, and firm technological knowledge); and with the external market (technology transfer, inter-firm relationships, market intelligence, and collaborative technical development). Moreover, these concepts can be viewed as heterogeneous marketing resources, and as such, have practical application in firm technology transfer effort.

7.26 A New Conceptual Framework for Industrial Marketing Practice

Figure 7-1 presents a new conceptual framework for marketing's role in firm technology transfer. The marketing concepts of 'technology transfer', 'market intelligence', 'technological knowledge', and cooperative and collaborative 'relationships' are conceptualised as resources that are deployed in the external and internal markets. In this way, marketing's role in technology transfer involves (i) gathering external ‘market intelligence’ to inform internal market innovation and technical development, and to identify opportunities for external market collaboration; (ii) promoting and developing firm internal cross-functional cooperation and external collaborative ‘relationships’; (iii) combining internal technical capabilities with external market intelligence to develop firm ‘technological knowledge’; and (iv) facilitating firm ‘technology transfer’ through matching internal market technical capability with market intelligence and external market relationships.

The framework is significant in that it accommodates the meta-patterns identified by the study that exist in contemporary marketing theory and practice and in the empirical data, and as such, serves as a bridge between theory and practice. It also accommodates the economic need for contemporary industrial firms (and hence marketer’s) to innovate, develop, and transfer technology products and services for competitive market advantage using strategies to develop the internal *and* external markets. Further, the model is significant because it provides practitioners with an alternative to marketing’s 4Ps approach, considered by this study, and marketing theory, to be a somewhat outmoded guide for marketing’s role in firm technology transfer effort. Lastly, the model provides theorists with an opportunity to reconceptualise marketing’s role using the more contemporary literature concepts of ‘relationships’, ‘technological knowledge’, ‘market intelligence’ and ‘technology transfer’ as a new ‘mix’ to guide marketing practice.

Figure 7-1: A Conceptual Framework for Marketing’s Role in Firm Technology Transfer

7.27 The Conceptual Framework and the voice of the customer

If it can be said that meeting the needs of the customer embodies the marketing concept, then it could be argued that comparing and contrasting the conceptual framework for marketing's role in technology transfer (Figure 7-1) with data collected from CRI external customer interviews provides a useful mechanism to gauge its efficacy from the perspective of the customer.

The intent here was to put the conceptual framework to the test, so to speak, and to demonstrate its efficacy as a useful framework or guide for industrial marketing practitioners, which is an objective of the study. Thus by introducing the voice of the customer, comparisons can be made with marketing patterns from the *Case* and from theory and practice.

The customer interviews consisted of three in depth and semi structured interviews with an average duration of one hour, with each interviewee representing a different sector group[33]. Additionally, the researcher facilitated a number of 'morning tea discussions' with managers from each of the customer firms to augment the themes from the interview data.

[33] The sector groups represented were the NZ Wine industry Association, Zespri, and the Port of Tauranga.

Consistent with the *Case* data, the CRI customer interviews revealed marketing themes that closely matched those expressed by the CRI scientists and marketers. In particular, the meta-patterns of inter and intra-firm relationships, collaboration, and firm technological knowledge identified in the Key Findings repeated in the customer data.

Each interviewee reinforced the need for the deployment of marketing resources in technology transfer, the gathering and dissemination of market intelligence, the importance of marketing and technical knowledge, and the requirement for collaborative relationships, reinforcing the usefulness of the conceptual framework for industrial marketing practitioners.

Additionally, each interviewee made the distinction between marketing activities associated with the 'internal market' and the 'external market', further reinforcing the study's findings that cooperative activity between internal CRI science and marketing functions and collaborative activity between the CRI and its external customers promoted effective technology transfer and better met the R&D needs of the CRI customer.

Conceptual Framework	Voice of the Customer: Representative Quotes from the Customer Interviews
Technology Transfer	"CRIs in general seem very light on marketing people...in other words, there is hundreds of scientists, bunches of admin people and business managers who manage business things...but very, very few people in my view in CRIs that are focused on commercialisation. There might one or two or three people, it seems, it seems a very low proportion if the focus to commercialise and tech transfer."
	"I imagine, like if you had a bunch of people there whose job was to get this information out, working with industries the focus of the CRIs would be a bunch more people involved in that activity...so from my perspective some of the people I know in the CRIs there is very, very few in that area, and that is based... and scientists don't make good commercialisation people."
	"There is an inordinate amount of information out there already that is unassessed, I mean the universities are pumping out humongous amounts of information, so are the libraries, who knows where else...and it seems to be that New Zealand is focused on creating more knowledge, which is fine, but that is not where we need to focus, we need to focus on the other end, on how to get that knowledge to create a better economy."
	"What we have found is that the commercialisation step is often more costly and requires a broader range of skills than the initial research side, and it is critical that, in the development of the project that both CRI and the customer fully understand the resources that will be available for that commercialisation from the CRI, so that the customer is not left with a solution which is still got a significant amount of work for implementation."
	"We have got some examples at the moment which are working really well with one of the CRIs on the commercialisation of new varieties, so we have got the CRI people actively involved within the management steering groups for that commercialisation process. So they can see firsthand the issues of commercialisation and are able to put, feedback into that steering group, or even identify issues before they are fully apparent to the rest of the steering group. So that has been a invaluable."
Market Intelligence	"I think being able to, if you are networking and you have a network of people to call on them to sound ideas, to maybe you know someone who knows someone whose has got some part of the puzzle that you need to fit in there to make it all work or whatever...those networks of people in organisations is incredibly important, and in fact I think that is the thing that

	really makes or breaks it really." "What are the big learning's? It is really hard and I don't have the answers to it, but it takes a whole heap of people thinking and talking and discussing and networking and it takes a total focus on that, those important aspects, and I think that is what a lot of overseas companies do. They are focused on that type of thinking." "…because to me the scientist that is engaged with industry at a close understanding will have a much clearer idea of how the science will deliver what the industry is after, and the further away from that understanding the further your research will be, and that is plain as it can be." "The first part is doing background work on our business, getting up to speed with where our business is going in the future, and looking at understanding our existing product, this is operations, and identifying some synergies between the activities in an CRI to either allow us to develop opportunities that we are identifying or bringing to attention opportunities in relation to our strategic direction or identify skills and capabilities with some of the problems that we may have also identified. Often CRIs approach us and they tell us all about their skills and capabilities, and have little understanding or insight into our current business or our future business direction." "People in our business are very knowledge about their part of the chain, they are also often time short in relation to focusing on reviewing projects, and projects which appear to have a poor understanding or insight into our supply chain, or business, or networks will get dismissed very quickly." "He, or the supplier would have to familiarise himself with the industry, in that way. I mean the supply chain is a very intriguing part of, part of the industry as a whole, so if the supplier is specifically targeting the port he needs to familiarise himself with all the ins and outs of shipping, transport, the infrastructure around it, so we are talking port infrastructure as well as IT infrastructure, as well as supporting ports support structure, service providers needs and requirements…it is the whole kit and caboodle." "…well that is very important, they [CRIs] have to be aware what our requirements are and they have to be aware of what their product can do for us if they are trying to sell a product without understanding our business or perhaps understanding a product to an extent where it is more important for them to sell it to us or them being assured that it is the solution for us. That is something that we will never accept."

Firm Technological Knowledge	"...you can't be everything for everybody and it is better to leave that to other people who know about that, and just use them as the sounding board. In other words if you try and get to know everyone's business it is just too complex, it just, you know you only have x number of hours in the day, that is what I am thinking. But you know it would be the perfect solution if you did know what everyone's business is quite intimately through the value chain."
	"So it is a unified company, where it needs some tasks that are very different, commercialisation tasks are very different job to that of scientist…so yeah particularly I see CRIs as science organisations meddling in a little tech transfer dabbling and commercialisation if you see what I mean."
	"I think it's a hell of a lot of networking initially, I mean I think you have to network with scientists, you have to network people in your area, I don't think you can do over all science, you need to specialise in certain areas, and think gradually about this is what we know, or this is what these people know, there are opportunities here to get this information out and create wealth from it."
	"...and it is being really open-minded about it, in other words if you are talking to a bunch of scientists about research don't think of that as merely research, think of that as every activity that these people do, whether it is selling new lab equipment, created some idea, they came up with some gap they couldn't do research on, or they were out on a boat and developed a new type of outboard motor, or something, I don't know anything, don't just think about just what the scientist is doing, think about all the knowledge these people have and how can we create wealth from that knowledge in a totally open way."
	"…but we have found that it is valuable to have a dialogue and discussion and look at developing a project proposal which understands the opportunity or the problem stakes from the customer perspective, and then provides a range of options or approaches on how we can start addressing that, and then that allows a further conversation or discussion on which of those options are likely to have a better fit…"
	"Yeah exactly, I think that's it, and it takes two to tango, so the scientists need to be in that space as well. So I guess when you include scientists, part of the understanding that a CRI is not to just sit there and do great science, which is definitely part of their employment agreement, but it is a wider role, and they need to be able to interact with marketers or other people to get the information out."

Collaborative Relationships	"...the marketing opens up the thoughts and understanding to know what is actually there, and what is not and where the knowledge lies. So they need to work together."
	"I have never thought about that, I mean what I am trying to do here is bring the company marketers, from industries and our in house marketing team, the more generic marketers, together to work with the science people to, as a sort of partnership between marketing and science and develop projects that are going to deliver market outcomes to the industry."
	"Yes, it is, it is personally, everyone is different, but I think you have to see the whites of the eyes, you got to trust the person, but more and a relationship is build on trust and the longer you have a relationship the more you deal with someone or something, the more you, you know trust just doesn't come... I think it is vital, yeah no I think it is vital."
	"What to do with that science, and pushing it out to commercial success is incredible variable, incredibly complex and it is very, very hard, it equates a lot of different people in different positions in different companies to actually make it work. And it is not just one person knows everything, its, yeah it is very, very complicated. So each individual time it's often quite different. Depending on the product, depending on the service, depending on the companies you are dealing with, depending on everything."
	"And to me it would all come down to the person, almost certainly, if that person can get on with scientists, can network with scientists, can bring out the best for scientists so they open up and prepare to spend time with a scientist and CRIs, and then have a good people to brainstorm with about ideas and then develop that to the industry, I think that to me is the way I see it."
	"I guess a good example of this is in our, it is important that the CRI takes the opportunity to work within the cross-functional implementation and commercialisation teams within the business."
	"So what we want is a CRI to work with us as our commercialisation partner, but also be able to affective bring in networks and expertise through their broader relationships as opposed to having a CRI as a closed boundary organisation. That is probably the biggest area that we see, that often CRIs and we do have relationship, then they see us as a captive client, rather than you know building up a relationship where they are portal, where they have a strong understanding, but they can interface with other activities or technologies, which can develop the

	overall economic growth of both organisations.” “During the process, sorry during the introduction of course we need to establish straight away a good rapport. I mean if that is not the case then it is, we are going down the track of flogging a dead horse, might as well stop the process straight away.”

Table 7-1: Comparing Customer Interview Data with the Conceptual Framework

7.28 The Conceptual Framework and the author’s reflexive position

As was highlighted in the Methodology Chapter, it was important that the study acknowledge the author’s reflective position on both the process and the product of the study. If the conceptual framework for marketing’s role in technology transfer (Fig 7-1) can be viewed as the *product* of the study, the question then becomes *how has it been implicated by the authors reflexive position?* Answering this question invites the author to ‘reflect on being reflexive’.

As has been described in Chapter Three, the researcher has had practitioner experience of marketing and technology transfer in a number of New Zealand and Australian industrial firms. This experience facilitated development of a network of working relationships with CRIs, and with networked firms operating across multiple industry sectors. Benefiting from these relationships and networks, the author was able to embark on this study both as a researcher and as a practitioner with experience in the marketing and technology transfer effort of the research setting.

Implications for the product of the study

Effectively, the researcher had unrestricted access to multiple industrial firms, and their personnel, processes, business plans, and archival material. This unfettered access facilitated the observation and gathering of detailed impressions and descriptions of *Case* technology transfer and marketing effort, cross-functional interaction, and relationship development with individuals and teams. It also enabled the researcher to experience *Case* marketing and technology transfer effort from the perspective of the 'researcher as practitioner', and indeed, from the perspective of the customer and supplier.

While it could be considered that this 'closeness' and 'familiarity' with the research setting might influence the study's interpretation of the observations, documents, and the raw data, the proposition here is that the author's reflexive position provided a unique opportunity for rich description of the phenomena under study in its natural, behavioural, and organisational context. Indeed because the study's objective was to develop a holistic role for marketing in firm technology transfer, it followed that the study *must* therefore take account of the individual, firm, and network perspectives. On reflection, achieving these 'multi-voice' reconstructions required a methodological 'capability' that, through the author's reflexive position, was able to develop a holistic role for marketing – the product of the study. In this way, the researcher's reflexive position promoted much deeper involvement in the research process and, interpretively, the research product.

7.3 Section Three: Recommendations for Theory and Policy Development

7.31 Recommendations for Theory Development

While the study has explored and interpreted a more holistic and expansive role for marketing in industrial firm technology transfer, there remains considerable scope for theory development that reflects the changed marketing environment. For marketing researchers, this suggests a quite critical need for re-conceptualising marketing's role, and more particularly for theory development that reflects a greater interest in the managerial aspects of networking, and in conceptualising and developing the firm's ability to successfully develop and manage its internal and external relationships. The problem for the firm and for marketers is how to manage their interactions with others so as to develop, preserve, and promote a productive and valuable role in the networks of which they are a part. Thus the challenge for marketing scholars will be to develop theory that defines this ability and explores how it can be conceptualised.

This is important because academic programmes continue to teach the 4Ps concept of marketing as the 'framework' from which students are encouraged to conceptualise marketing. For example, a 2009 university examination paper asks:

> "A positioning strategy is implemented by means of a well-coordinated 4Ps marketing mix (product, price, promotion, place). Explain the key considerations involved in putting together an effective 4Ps marketing mix."

It is not surprising that this 'ingrained' concept of 4Ps marketing thinking continues to have an effect on the way students, and ultimately managers, conceptualise marketing and its role in the contemporary business environment. Reinforcing this, an impromptu survey of university third and fourth year marketing students asked the question "in a paragraph or less, explain what marketing and the concept of marketing means to you". The students' qualitative responses corroborate the study's assertion, and indeed that of the literature, that the 'marketing concept' continues to be misunderstood and outmoded, being variously described in the survey as:

- "Selling products or services to people at a profit"
- "Understanding customers and creating value with them"
- "Marketing is engaging with your customers or business partners in order to create value together"
- "An exchange of value (goods or services) between a firm and its stakeholders"
- "4Ps – the way of communicating products and services to all possible people"
- "4Ps for a good or service in the market place"
- "Giving customers what they want, working together to co-create value for business and customers"
- "Communicating the customers viewpoint to the company"
- "Letting the world know the benefits, capabilities, and values of a particular product or service"
- "Process of promoting, selling, advertising, and creating value for services and products".

The point here is that, while there is nothing inherently wrong with these answers, they nevertheless bear little resemblance to the *actual* role that marketing plays in industry. For example, while there is some reference to the co-creation of value, the concepts of ‘knowledge transfer’, ‘market intelligence’, and the importance of ‘relationships’ and the ‘internal market’ are not mentioned. Neither is the importance of firm technological knowledge. As this study and the literature have shown, these theoretical constructs have become vital concepts for marketing practice and for firms seeking to create economic value and market advantage. Thus in a general sense, much work is yet to be done with respect to developing marketing theory and its role in the contemporary business environment.

In the context of this study, a central premise is that the concepts of ‘collaborative relationships’, ‘market intelligence’ and ‘technological knowledge’ can be considered *vital* marketing resources that allow firms to compete not just on the basis of offering technology products and services, but also through exploiting, in tandem, the underlying resources and capabilities associated with technology innovation, development, and transfer effort. The idea that firms can view resources and capabilities as marketable assets has been the focus of growing attention by researchers (e.g. Barney, 1991; Fredericks, 2005; Galende, 2006), including the conceptual development of new ways for ‘value creation through exploiting the capabilities utilised by the firm in creating its products’

(Blois and Ramirez, 2006). However, to do so effectively poses a challenge and an opportunity for marketing theorists, particularly in determining the theoretical interrelationships that exist between the concepts of 'technological knowledge', 'market intelligence' and 'internal and external relationships', or indeed in the determination of new ways to conceptualise 'customers' (as co-creators) and 'markets' (as technological knowledge networks) and 'marketing activities and practices' (roles).

Further, recent marketing research (Möller, 2006) has begun to examine how customers and suppliers perceive value, and their roles in value creation - raising more important questions for marketing theory development and practice. For example, marketing theory is in the early stages of examining what constitutes *value* in business-to-business marketing and the kind of competencies and processes that create value in a knowledge economy. Indeed, strategic and marketing authors argue that RA theory, because of its basically intra-organisational orientation, does not adequately cover the fundamental processes by which resources are transformed into something that is of value for customers (Golfetto, and Gibbert, 2006; Priem and Butler, 2001; Ritter, 2006; Srivastava, Fahey, and Christensen, 2001; Zerbini, Golfetto, and Gilbert, 2003). By focussing on marketing resources and competencies, products become less central and as such, competition occurs on dimensions beyond 'product' and 'price'. This line of enquiry suggests that, while products can be analysed and copied by competitors, firm specific competencies are harder to understand and are thus harder to replicate.

This raises two very important questions for industrial marketing scholarship. Firstly, how can the firm build its marketing resources so that they become capabilities that are not easily replicated by the competition, and thus allow the firm to avoid competing on the basis of product, price, promotion, and place? The premise here is that firms may argue that their technologies enable market leadership today, but further, that their competencies (marketing resources) allow them to lead in the future. For scholars like Ritter (2006), such competencies can be the basis for long-term relationships, perpetuating the firm's competitive advantage.

Secondly, how can these firm level competencies be 'packaged' and marketed to customers and networks? Although RA theory recognises that the value of resources is determined by the market context within which the firm is operating (Barney, 2000) and that marketing related resources such as 'relationships' or 'technological knowledge' are valuable (Ritter et al., 2004; Srivastava et.al., 2001), it does not address the processes of transforming resources and capabilities into opportunities for customer value creation. Put another way, the challenge for marketing theorists here is developing a clear understanding of how firms develop an understanding of their own competencies, not so much in internal market terms, but in terms of customer benefits and the need for a 'marketing mix of competencies'. Thus there is a clear need for research that explores inter-organisational collaboration and value creation in an environment where the roles of suppliers and customers are now complex and intertwined, and firm network resources promote innovation and technology transfer. In this way, the development of collaborative resources can be theorised as a special kind of marketing competence. In many respects, this study is a step in answering these important questions for marketing theory development, and for industrial marketing practice.

7.32 Research Limitations

Aside from considering several avenues for further research, it is acknowledged that this exploratory study has a number of limitations. Chief among these include the limited number of firms involved, and their nature, being large scale industrial R&D organisations owned by the New Zealand Government. The study did not include private sector R&D organisations or SMEs' which may differ from the *Case* in their approach to technology transfer and their conception of marketing's role, and thus further research is required to test the efficacy of the conceptual framework (Figure 7-1) and its usefulness as a basis for marketing theory development and practical application.

Secondly, the four firms within the *Case* have their origins as fully funded research providers, and despite more than a decade of public policy demanding increasing levels of industry engagement (market connectivity) - as opposed to the pursuit of pure science, there remains a vestige of 'institutional memory' that, along with actor 'marketing prejudice', may limit engagement with the marketing concept and commercialisation effort. Certainly the raw data suggests that CRI science and technical staff continue to 'misunderstand' the marketing concept, or are 'mistrusting' of the marketing function.

Thirdly, the study focussed on marketing/commercial and science/technical effort, and so did not involve actors from other functional areas. This is a particular limitation in that other functional roles, given the new economy, have also been subject to change, and thus may offer new opportunities' for cross-functional (i.e. operational and/or administrative) engagement with internal and external marketing effort. This may be an especially important consideration given the reliance this study places on the 'internal market', 'relationships', 'cooperation', and the development of firm 'technological knowledge'.

Fourthly, the study chose to consider the empirical data using the lens of RA theory, as opposed to theory development from other, equally valid, perspectives. As was shown in Chapter Two, 'structuration', 'role', and 'contingency' theories are all examples of alternate perspectives from which it is possible to evaluate marketing's role in firm technology transfer, suggesting a limit to the study's claim of generalisation.

7.33 Recommendations for Policy Development

Given the importance the Government places on New Zealand's participation in the 'knowledge economy', the findings of this study have quite significant implications for policy development in the Vote: Research, Science, and Technology (RS&T) portfolio. The implications relate to the two broad areas within RS&T that have been identified by the MoRST as having the 'greatest potential impact' for New Zealand economic development (MoRST, 2008): (i) complimenting a strong bio-economy sector by building an equally strong technology sector, and (ii) getting better at utilising the benefits of investments in public good research. Within this broad strategy, the intention is to develop the capability of Crown Research Institutes so that they are more able to:

1. Effectively transfer knowledge between research organisations and industry bodies
2. Effectively orientate (match) research effort to business needs
3. Effectively facilitate industry exploitation of the opportunities that are identified by research and development effort (p. 5).

While these objectives are appropriate and timely in a knowledge economy, they nevertheless expose a significant challenge for policy makers in respect to the ability of CRIs and New Zealand industry to *actually* deliver on the stated objectives. Without this ability, RS&T policy development is, like normative marketing theory, in danger of becoming divorced from its practical application. Indeed, the findings suggest that, in meeting the RS&T policy objectives, significant challenges await the CRIs with respect to:

1. Determining the nature and extent of the inter and intra-firm relational resources required to *effectively* transfer CRI technical capabilities and technological knowledge to industry networks and customers
2. Determining the nature and extent of the market intelligence, technological knowledge, and external relational resources required to *effectively* match CRI science effort to business needs
3. Determining the nature and extent of the marketing resources required to *effectively* promote a*cross-CRI* (read: *across* the science system) technical capability and technological knowledge so that the combined heterogeneous capabilities create new opportunities for New Zealand industry competing in global markets.

From the perspective of this study, the challenge for policy development does not concern the creation of a national scale 'policy ideal' that directs CRI (and New Zealand industry) effort towards knowledge capture, innovation, and technology transfer. Rather, instruments are urgently needed that facilitate and promulgate a shift in attitude by the wider science system (and New Zealand industry) toward the development of marketing and networking competencies that ultimately *enable* the connection of knowledge, innovation and technical development to external markets. Unquestionably, world class scientific and technical capabilities exist within *and* across the CRIs, but without an ability to 'close the loop' through the deployment of marketing resources, these capabilities *cannot* be realised. Thus, promoting the deployment of marketing resources within (CRIs) and across (MoRST) the New Zealand science system must now become a primary consideration for policy makers because science strategy, without marketing capability, is impotent. Thus the challenge for policy makers has moved from a position of 'command and control' to one of promoting cooperative relationships within and between CRIs, their funders, and industry at large. In this way, policy makers become participants in the technology transfer process, learning to adapt and respond to what CRIs and industry are doing in the way that jazz ensembles interact to co-produce good improvisational music.

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