EXTRACTS FROM PETER WOODGATE'S DOCTORATE OF BUSINESS ADMINISTRATION THESIS, RMIT UNIVERSITY, NOVEMBER 2007

INNOVATION IN THE AUSTRALIAN SPATIAL INFORMATION INDUSTRY:

INCENTIVES AND IMPEDIMENTS

By

Peter Wyndham Woodgate

Masters of Applied Science (UNSW)
Bachelor of Forest Science (UMelb)
Diploma of Forestry (Creswick)

This thesis is submitted in partial fulfilment of the requirements for the degree of

DOCTOR OF BUSINESS ADMINISTRATION

At

School of Management

RMIT UNIVERSITY

November 2007

EXTRACTS FROM PETER WOODGATE'S DOCTORATE OF BUSINESS ADMINISTRATION THESIS, RMIT UNIVERSITY, NOVEMBER 2007

1 RESEARCH DESIGN AND RATIONALE FOR THIS THESIS

"Perception and wisdom are closely allied. Cleverness is a sharp-focus camera. Wisdom is a wide-angle lens…Wisdom can come with age and experience so you learn to recognise complex possibilities. Wisdom can also be obtained at an earlier age by learning to broaden and enrich perception. You need to look widely. You need to look at alternative possibilities (enrich). You need to look more deeply – into the future."

and

"***The information age is over. Information is no longer the bottleneck. Thinking is the new bottleneck***."
(Edward De Bono, (1999), 'New Thinking for a New Millenium').

1.1 OBJECTIVE OF THIS CHAPTER

In the previous chapter a comprehensive review of the literature identified many factors that operate to affect innovation. The review showed how these factors come together through the process of innovation to influence the viability of firms. This chapter sets out the research questions that the thesis intends to address, outlines the rationale for the research method, explains the research strategy, covers the design of the research plan, and considers the elements of data collection and data analysis. A realist research method and inductive research strategy were employed for the data analysis.

1.2 FACTORS THAT CONTRIBUTE TO INNOVATION

The following factors have been identified as having an impact on the ability of firms, and those individuals within them, to induce innovation. They have been identified

through a combination of literature review and this researcher's personal experience. They are to form the basis of the data collection phase of the research:

1.2.1 External to firm

- **General policies of the Commonwealth government** (for example 'Backing Australia's Ability' the $3 billion science and innovation program of the Australian government (see section 1.9))
- **Export incentive schemes**
- **Government legislation at Commonwealth or State and Territory level that operate to impede innovation in the firm, and the amount of business regulation generally** (for example R&D taxation schemes, or labour laws)
- **General policies of the state government** (such as the many state-based innovation grant schemes for sme's)
- **Use of government funded 'diffusion' coordinators** (such as the state funded positions offered to universities to help broker research partnerships between industry and the universities)
- **R&D tax rebate level**
- **Privacy and security legislation** (that is increasingly operating to limited the distribution of some datasets such as personal addresses, demographic data and so on)
- **Australian Research Council linkage grants, AusIndustry discovery grants and similar grants**
- **Early phase seed investment funds from venture capital sources**
- **Australia's patent system**
- **Australia's copyright system**
- **Free trade agreements**
- **Ability to protect IP other than patents**

- **The culture of Australia in relation to innovation** (including the general attitude of investors and customers to local IP and to overseas IP)
- **The cost and effort involved in finding out about government support programs**
- **The presence or absence of innovation parks or incubators or centers of excellence** (such as a silicon valley)
- **The quality of Universities, CSIRO other research organisations** (there are many dimensions to this issue including; the quality of their research and researchers, their willingness to collaborate, the perception that they can be competitors to industry)
- **Geographic penetration of the wireless (high speed) broadband network**
- **Education and skills gap**
- **Assistance for public-private partnerships to aid research and development** (such as the Australian Cooperative Research Centre programme and the Canadian National Centres of Excellence program)
- **Learned appreciation of the need for innovation from university graduates**
- **Overseas brain drain**

1.2.2 Internal to Firm

- **The strategic plan and key objectives, particularly the R&D component in that plan**
- **Budget allocation to R&D (and innovation) as percentage of total turnover, the past trend in this allocation and future intentions**
- **The presence or absence in the firm of a core ideology that promotes, or otherwise, innovation**
- **The day-to-day culture of the firm, particularly its attitude to innovation**
- **The firms' use of specific techniques to link strategy, R&D and innovation** (eg foresighting, think tanks, consultants reviews etc)

EXTRACTS FROM PETER WOODGATE'S DOCTORATE OF BUSINESS ADMINISTRATION THESIS, RMIT UNIVERSITY, NOVEMBER 2007

- **The presence or absence of an organised, systematic and continual search for new opportunities**
- **The presence or absence in the firm of the practice of product life-cycle management with innovation as an explicit factor**
- **The presence or absence in the firm of the practice of continuous product improvement coupled with sound communication systems throughout the organisation**
- **Understanding technology and market trends**
- **The use of technology roadmapping**
- **Practices of the firm in relation to innovation including:**
  - **developing a project vision**
  - **documenting the project development system**
  - **establishing project deadlines**
  - **specifically focusing on communication throughout the development**
  - **avoiding bureaucracy**
  - **business process re-engineering**
  - **the propensity to evaluate innovation successes and failures and feedback that knowledge to other members of the firm**
  - **managing time lags, poorly management success hurdles, and spreading the effort over the too many ideas at once**
  - **managing the risk of innovation**
- **Alliances with other firms and alliances with research organisations**
- **Access to finance for innovation from whatever source**
- **The degree to which leadership is shown in relationship to innovation in the firm**
- **Recruitment policies of the firm – identifying individuals with innovation (R&D) potential and the use of testing during recruiting to establish the likely level of creativity or innovativeness (eg Myers-Biggs)**
- **Training and skilling policies for existing employees**
- **Career path – internal and external**

- **The innovators access to senior management**
- **Appointment of a 'champion' for progressing a new idea**
- **The approach to establishing standards of high quality in managing innovation**
- **The strength of the relationship with customers and the firm's willingness to involve customers in new product and service development**
- **Entrenched fears about change that may occur as a result of innovation. This potential impediment invokes a social and cultural dimension**

1.2.3 Of the individual innovator

- **Their knowledge of the needs of the market in relation to their knowledge of the technology.** This factor recognises that innovators cannot innovate with technology unless they have some understanding of the technology needs of the market.
- **Their level of prior market knowledge (such as future customer needs, or competitors products)**
- **Perceived level of support (including leadership) from management generally**
- **Perceived level of support specifically from the CEO**
- **The issue of whether innovators have an understanding of what is meant by R&D and its role in the firm**
- **Expectation of the individual in relation to the personal reward system and incentives for the individual innovator:**
  - **remuneration**
  - **bonuses**
  - **profit sharing**
  - **share options**
  - **added responsibilities**
  - **promotion**

- **being singled out for recognition in reports, newsletters**
- **intrinsic motivation (fun, the challenge, sense of achievement etc)**
- **freedom at work**
- **other forms of reward**

- **Limitations placed by the firm on the career path of the innovator/researcher/technician that are less restrictive than for that of the managers (such as the presence of a 'dual ladder' of promotion in the firm?)**

EXTRACTS FROM PETER WOODGATE'S DOCTORATE OF BUSINESS ADMINISTRATION THESIS, RMIT UNIVERSITY, NOVEMBER 2007

- **Personal factors from highest to lowest in terms of their ability to influence innovation:**
  - **persistence**
  - **age**
  - **personal creativity and lateral thinking**
  - **curiosity**
  - **initiative**
  - **creativity**
  - **knowledge**
  - **skills**
  - **attitude**
  - **opportunism (and serendipity)**
- **The perception of the individual about the management structure of the firm and its influence over the ability to innovate**
- **Personal knowledge inherent to the innovator of how to bring the innovation to market**
- **The innovator's understanding of the business drivers in the firm**
- **The innovator's opinion of the CEO's understanding of what drives research and innovation to be successful in the firm**
- **The innovator's view of the core ideology of the firm ideology and their ability to influence it through time**
- **Barriers to innovation including lack of knowledge of customer needs, lack of knowledge of technology trends, lack of skilled people, and inappropriate management structure**

In all over 60 factors of innovation were identified.

1.3 RESEARCH QUESTIONS THAT EMERGE FROM THE LITERATURE REVIEW

The literature offers a variety of views about the relative merits of the factors of innovation and their ability to make a systematic and convincing contribution in relation to stimulation of innovation. These factors operate both individually and in concert. The literature review also revealed that there are virtually no references relating specifically to innovation in the spatial information industry in Australia or world-wide.

The questions that emerge from the literature review in relation to innovation in the spatial information industry and with specific reference to small to medium enterprise firms in Australia are:

1. *How do Australian firms in the spatial information industry manage innovation?*
2. *What are the factors that CEO's and innovation leaders perceive to be operating to assist innovation?*
3. *What factors do CEO's and innovation leaders perceive to be operating to impede innovation?*
4. *How important is innovation perceived to be by CEO's and innovation leaders to success in this industry?*
5. *How could improvements be made to the management of innovation?*

1.4 RESEARCH METHOD

In the context of research, methods are the procedures that are used to try to understand or explain a topic under investigation (Blaikie, 2000, pp: 8-9, and citing Mills, 1959, pp: 57-8). Methodology is a study of methods, and since there are many methods, methodology tends to be a general overview (Blaikie, 2000, pp: 8-9, and citing Mills, 1959, pp: 57-8). There are many different approaches to research (see Blaikie (1995, and 2000), Burrell and Morgan (1979), Yin (1984, 1994), Evans and Gruba (2002), and Creswell (1998) to name just a few). Typically they deal with the logic of enquiry and

explain how new knowledge is generated and justified. With studies that are concerned with human subjects the researcher is known as a social scientist.

This thesis so far has identified over 60 discrete factors that can be brought to bear to influence the practice of innovation. This thesis proposes to investigate the practice of innovation by firstly using a questionnaire to elicit specific information on the current practices of innovation in use in five selected firms and then through a series of in depth interviews with selected individuals from the same firms. This will be followed a survey questionnaire that will be sent to several hundred members of the spatial information industry in Australia. This thesis is therefore both a qualitative one and a quantitative one. The following sections set out the detailed approach for the chosen research method and provide an outline of the theoretical basis that supports it.

1.4.1 Methodological framework for the research

This thesis has accepted a preferred definition of research (and experimental development) (DEST, 2005, and OECD, 2002) as being '*creative work undertaken on a systematic basis in order to increase the stock of knowledge, including knowledge of humanity, culture and society, and the use of this stock of knowledge to devise new applications***'.** From a philosophical point of view our ability as researchers to systematically conduct research depends very much upon the perspective that we bring to bear in the study of the chosen research topic. The issue of perspective is expressed by social scientists as the study of the nature of reality, formally known as ontology. The ontological issues for the social scientists include the assumptions that make up social reality, claims about what exists, what it is made of and how the various aspects of reality interact (Blaikie, 2000, p8).

Equally important to the social scientist is the study of knowledge itself; its origin, nature, methods and limits (Gibson pers com 2002) and ways in which it is acquired as a social and physical reality (Blaikie, 2000, p8). This is known as epistemology.

EXTRACTS FROM PETER WOODGATE'S DOCTORATE OF BUSINESS ADMINISTRATION THESIS, RMIT UNIVERSITY, NOVEMBER 2007

Various researchers have erected different research frameworks[1] that permit the systematic evaluation of research subjects using a framework of ontological and epistemological assumptions. Blaikie's (1993) methodological framework includes such individual methods as Interpretivism, Positivism, Structuration Theory, Critical Rationalism and Realism. It is this latter methodical approach that applies most to this thesis.

The Realist ontology is one where the subjects of the scientific enquiry act quite independently of the research scientists conducting the study (Blaikie, 1993) and assumes that the research is addressing complex social phenomena involving reflective people (Healy and Perry, 2000). It recognises that reality can be described in three different ways; the empirical that comprises experiences of events through observation, the actual that includes events whether observed or not, and the real that consists of the processes that generate events (Blaikie, 1993). It sees a socially constructed world that is made up of the cognitive resources of the actors (the subjects of study) and/or the less well defined processes that underpin the relationships of the actors and the environmental influences on them. Popper (cited in Magee, 1985, p61 and Healy and Perry, 2000) describes the world of realism as consisting of abstract things that are born of people's minds but exist independently of any one person. The Realist epistemology is based on the building of models that help provide a scientific theory that explains the mechanisms of cause and effect (Keat and Urry, 1975 as cited in Blaikie, 1993) and Burrell and Morgan (1979)[2]. This approach therefore distinguishes realism at the objective end of the spectrum to the subjective at the other.

In simple terms the Realist research method is seeking to discover what is really going on. As Healy and Perry (2000) observe "*…the participant's perception for realism is a window to reality through which a picture of reality can be triangulated with other perceptions*…". This thesis is looking to better understand the relationship between the

[1] Yeung (1997) has noted that in philosophy there are many varieties and versions of realism which are not all entirely compatible with each other. This study has therefore made some generalisations in its interpretation of the Realist method.

[2] For a fuller description of the methodological frameworks of Blaikie (1993) and Burrell and Morgan (1979) respectively refer to Appendix B.

innovators and their organizations (the actors), the causal factors (of which over 60 have been identified through the literature) and the processes that generate the innovation itself.

The features of the Realist method are summarised in Table 3.4.1.

EXTRACTS FROM PETER WOODGATE'S DOCTORATE OF BUSINESS ADMINISTRATION THESIS, RMIT UNIVERSITY, NOVEMBER 2007

	SUMMARY DESCRIPTION OF REALIST METHOD
	The researcher acts independently of the activities of the actors (subjects being researched).
	Is a socially constructed world based on the cognitive resources of the actors and or the social relationships of the actors. Seeks to explain the observable phenomena by understanding the underlying structures and mechanisms.
	Is based on models that that explain the observed phenomenon. The underlying science is empirically-based and seeks to understand the connection between phenomena by acquiring knowledge of the underlying structures and mechanisms.
	The Realist methodological framework looks to tangible evidence. It seeks to explain the causal relationships by describing the governing principles and laws. It assumes that people are strongly influenced by their external environment. It acknowledges that society is subject to

	SUMMARY DESCRIPTION OF REALIST METHOD
	pressures for change.

Table 3.4.1: Summary description of the features of the Realist Method chosen for this thesis. Based on Blaikie (1993), Burrell and Morgan (1979) and Keat and Urry (1975).

1.4.2 Research strategy

The research strategy deals with the logic of the enquiry[3] . The principal aim of the research strategy is to achieve the best procedures for answering the research questions. Blaikie (2000) notes that inductive strategies are best used for answering the 'what' questions while abductive strategies can be used to answer the 'what', 'why' and 'how' questions.

This thesis takes a case study approach to its research followed by a comprehensive survey of companies involved in the Australian Spatial Information industry. Yin (1994,

[3] Blaikie (1993) describes the four main research strategies as: **Induction**, which is the making of careful observations through carefully planned experiments, followed by rigorous analysis to produce a theory; **Deduction**, where the deductive strategy begins with a question or problem that needs to be understood. A theory or hypothesis is then developed which is tested through observation and data gathering. It is either proved false or corroborated; **Retroduction**, which proposes a theory or model that may not have been or could not have been directly observed. It then looks at the underlying structure or mechanism that is responsible for the observations. Experiments are conducted and the theory refined accordingly; **Abduction**, which takes everyday concepts and meanings from social actors, from whom scientific descriptions can be made.

p 13) has identified a number of the key characteristics of research that make case studies a suitable choice [the statements in square brackets relate the principles of Yin to the circumstances of this thesis]. The case study:

- Are an empirical inquiry that investigates a contemporary phenomenon within its real-life context, especially when the boundaries between the phenomenon and context are not clearly evident [innovation and its outcomes are a function of the involvement of the innovator, their colleagues, their organization and the external environment. The inter-relationships are complex]
- Copes with the technically distinct situation in which there will be many more variables of interest than data points [the literature review has revealed over 60 factors that influence innovative capacity, many more than the number of innovation case studies that can be reasonably covered by this thesis]
- Therefore relies on multiple sources of evidence, with data needing to converge in a triangulation fashion [this thesis proposes to usefully employ questionnaires, interviews, existing documentation and other information]
- Will result in benefits from prior development of theoretical propositions to guide data collection and analysis [the 60 factors of innovation from the literature set up a proposition that can be tested by case study analysis].

Yin (1994) also makes the point that case study research can include both single and multiple case studies.

One of the other benefits of case studies is that they allow multiple sources of information to be examined thereby increasing the depth of analysis and the degree of reliability and independent validation. These sources include documentation (both new and archival), interviews, direct observation and participant observation (of events by the actors and the researcher in context, and in real time), and physical artifacts (such as the products of the actors).

1.4.3 The research plan

Thus this thesis proposes to take an inductive approach to the collection of data through questionnaires completed by innovators and managers from selected companies. It will then combine the results of the responses with a further examination of the factors of innovation identified from the literature to produce an outline of the elements of a methodology of innovation. This will be followed by a series of face-to-face interviews with the same individuals and the use of an abductive approach to get a better understanding of the inter-relationships between the individuals and the way in which the factors of innovation influence the underlining processes. A survey questionnaire will be used to collect data from a large number of Australian-based companies in the spatial information industry to permit a quantitative analysis of many of the factors of innovation identified by the literature review and refined by the case study interviews. Finally a methodology of best practice for the management of innovation in the spatial information industry will be prepared.

The research plan consists of the following components:

1. A comprehensive review of prior work including a thorough literature review
2. Use of a questionnaire to elicit preparatory information to help design the case study. Five firms will be selected for the questionnaire. In those firms selected respondents will include the CEO and innovators, the latter in some firms also serving as the Chief Information Officers. Czaja and Blair (2005) note three fundamental requirements for a good questionnaire survey; it is a valid measure of the factors and research questions of interest, it convinces respondents to cooperate, and it elicits acceptably accurate information.
3. Completion of five case studies.
4. Completion of a general survey of companies in the Australian spatial information industry.
5. Development of a methodology of best practice management of innovation in firms in the Australian spatial information industry.

1.4.4 Design of the case study and the subsequent quantitative survey

Creswell (1998) describes the traditional case study as being a bounded system such as a process, activity, event, program, or multiple individuals.

EXTRACTS FROM PETER WOODGATE'S DOCTORATE OF BUSINESS ADMINISTRATION THESIS, RMIT UNIVERSITY, NOVEMBER 2007

Yin (1994) identifies the five components of good case study design:

1. The questions of this thesis

These have been formulated as:

How do Australian firms in the spatial information industry manage innovation?

What factors are operating to assist innovation?

What factors are operating to impede innovation?

How important is innovation perceived to be by CEO's and innovation leaders to success in this industry?

How could improvements be made to the management of innovation?

2. Its propositions (if any)

There are no propositions *per se* other than that which is inherent in answering the research questions. However it is useful to note that many researchers have identified innovation as a vital factor in the success of any organization. The spatial information industry in Australia is made up of hundreds of companies, most of them sme's. There are no studies of the practice of innovation of sme's in the spatial information industry in Australia or elsewhere. This researcher is in the fortunate position of being involved in a national research centre that has over 40 sme's from this industry as its partners. The centre also works closely with the Australian Spatial Information Business Association (ASIBA) which itself has around 500 members. ASIBA has indicated that it is pleased to be able to cooperate in the study by providing a letter of support and giving access to its membership list.

3. The unit(s) of analysis

The units of analysis chosen for the case studies are drawn from five companies operating in the Australian spatial information industry. In order to preserve confidentiality they have been given the following code names; ANU, DAMONA, CORRA, ESUS and

LATIS. Specifically each case will consider as its unit of analysis the processes by which innovation takes place within the organization and the factors that comprise those processes.

The five companies were selected on the basis of the following criteria:

- are information rich
- offer significant replication and rigour
- have been in operation for at least 5 years in Australia
- are clearly identified with the spatial information industry in Australia through their own recognizance and that of their peers
- operate a range of the technologies in the industry
- were willing to participate in the study

Each of the five is also widely recognised as being amongst the leaders in terms of the success of their operation over many years.

This component of the thesis is therefore one of multiple case studies. It is followed by a second component that comprises a quantitative survey.

4. The logic linking the data to the propositions

The logical consistency of the research sees the proposition establish the research questions. These are reinforced by the findings of the literature review. Together this information permits a comprehensive series of points to be explored through the questionnaires, interviews and through the study of other supporting data. The preliminary outcomes of the case studies were then used to refine the survey questionnaire for subsequent distribution to the membership of ASIBA to permit some quantitative analyses.

5. The criteria for implementing the findings

The five case studies explored the relationship amongst a number of examples of innovation and the factors that influenced the expression of that innovation in real life. The list of proposed factors of innovation was comprehensively compared with the case

study data and inferences drawn about the role each factor played. A revised list of factors was then prepared with justification drawn from the case study material.

Yin (1994) suggested the use of a case study protocol that would enable another researcher to independently replicate the results. This thesis will conform to that protocol. The expected outcomes of the case studies were:

1. A working theory of the critical factors of innovation stratified by the three levels of innovation identified in the literature review, Chapter 3. This will be supplemented by analysis of appropriate investment levels commensurate with perceived risk and benefits.

2. Identification of the relative importance of the contribution made by each factor and stratified according to source (eg external to the firm, internal to the firm, and specific to the individual).

3. Identification of impediments to innovation.

4. A comparison of the respective views of the CEO and the innovator in the one firm highlighting areas of agreement and disagreement.

5. Understanding of the way the Australian spatial information industry manages innovation.

6. An opinion on the question of the degree to which innovation can be fostered by nurture (planning), or is inherited through nature (luck).

1.4.4.1 Limitations of Case Studies

Yin (1994) also cautions that there are a number of limitations to case studies that must be carefully managed. These include that they are qualitative and as such can permit sloppy research that leads to subjective bias. They can be a problem when generalizing, and can take too long and generate more information than is useful or necessary.

1.4.5 Selection of subjects and elicidation of information

Those chosen to complete the case study questionnaire were the CEO (who in some cases also operated as the Chief Information Officer (or equivalent)) and one innovator from each of the five companies. The questionnaire was comprised mostly of closed questions seeking definitive answers to the 'what'.

The face-to-face interviews for the five case studies followed the questionnaire and pursued the 'why' and 'how' issues suggested by the questionnaire and that were reinforced by the literature. They were used to support the more detailed case study investigations that were conducted on a subset of the companies. The questionnaire and face-to-face interview issues are given in Appendix A as is a letter of introduction seeking approval to conduct the collection of information in each firm. All interviews were taped with the permission of the subjects. Notes were taken during the interview. Sources of all other forms of information were documented. All information was coded and entered into a database where appropriate and subject to the confidentiality regulations of RMIT University.

Following refinement of the factors of innovation through the case studies the questionnaire was refined and sent out to around five hundred firms. The firms chosen for distribution were either members of the Australian Spatial Information Business Association (ASIBA) or unit trust holders of the Cooperative Research Centre for Spatial Information (CRCSI). ASIBA has around 500 registered members and the CRCSI, which is an unincorporated joint venture, has 47 unit trust holders. Firms could be members of both organisations, although some of the members of the CRCSI are not members of ASIBA. All are considered to be part of Australia's spatial information industry. The industry-wide survey questionnaire was issued on line. A copy of it is given in Appendix B.

1.4.6 Data analysis

The following techniques for data analysis are proposed (based on Creswell, 1994, Yin, 1994 and the researchers own experience):

- General review of all information and the preparation of summaries
- Seeking out feedback, conformation, clarifications
- Preparation of charts, graphs, tables and codification through notation and databases
- Categorisation of information
- Data reduction
- Interpretation, cross-referencing, examination of convergent lines, classification, identification of trends, common themes and patterns, exceptions and generalizations
- And for the quantitative survey of the firms, statistical analyses will be used as appropriate

The analysis was reported in the form of a narrative from which the conclusions could then be drawn.

The following dimensions of analysis were proposed: factors of innovation (external to firm, internal to firm, specific to the individual), position in company (CEO, CIO and other innovators/researchers), firm size (from small sme's of around $3 million turnover pa to corporations in excess of $100 million pa).

1.4.7 Validation

Healy and Perry (2000) set out six criteria to help judge the validity and reliability of qualitative research in the realism paradigm especially when intended for use with case studies. They are:

1. Ontological appropriateness: when the research is dealing with complex social science phenomena focused on how and why problems.
2. Ontological contingent validity: open 'fuzzy boundary' systems when the research will be subject to both theoretical and literal replication seeking broad generative mechanisms.

3. Epistemology based on multiple perceptions of participants and of peer researchers: involves multiple interviews, supporting evidence, broad questions before probes, triangulation, self-description and awareness of own values but not value laden.
4. Methodological trustworthiness: need to develop a case study database, use of quotations and matrices to summarise data. The research can be audited.
5. Methodological analytical generalization: theory-building rather than theory-testing. Identify research issues before data collection to formulate an interview protocol that will provide data for conforming or non-confirming theory.
6. Construct validity: for use of prior theory, case study database, and triangulation.

A summary of the performance of the thesis against these criteria is given in Chapter 8.

Yin (1994) and Soy (1998) note that a well constructed design ensures construct validity (use of sound subjective judgment to build 'multiple sources of evidence' and 'chains of evidence'), internal validity (ensuring causal relationships are robustly established), and external validity (ensuring extrapolated inferences are sound). They also recommend multiple sources of information leading to convergent lines of enquiry and permitting cross referencing and triangulation. Yin (1994) also suggests the use of independent auditors to help validate the findings.

1.4.8 Ethics

This thesis has conformed with the ethical procedures established by RMIT University for the conduct of research. It has been approved by the RMIT Human Research Ethics Sub-committee.

Letters of introduction were sent to all participants seeking their engagement and explaining the purpose and conditions of the research. Attached to the letters of introduction were letters of consent to be signed off before the research commenced. The

letters guaranteed the confidentiality of the information provided by the individuals and their organizations and agreed to report with anonymity whenever requested to do so. Copies of the results could be provided to the individual contributors upon request. Privacy was offered in accordance with the prevailing laws of Australia.

The covering letter for the quantitative survey explained that participation was voluntary and consent and participation could be withdrawn at any time. It was jointly signed by this researcher and the CEO of the Australian Spatial Information Business Association (ASIBA). It indicated that participants could also request that any data that is supplied by them could also be withdrawn. Respondents were told that the website to be used for the collection of data on-line was secure. The information gained was to stored and locked in confidential files. The respondent's identity and that of their organisations was not to be disclosed. Data collected will be held securely according to RMIT University regulations for a period of five years after the completion of the project and then destroyed. Confidentiality and anonymity will were assured as only general statements will be reported.

2 A METHODOLOGY FOR THE MANAGEMENT OF INNOVATION IN THE SPATIAL INFORMATION INDUSTRY IN AUSTRALIA

"Freedom is always and exclusively freedom for the one who thinks differently".
(Rosa Luxemburg (1871-1919) Polish-German writer)

2.1 OBJECTIVES OF THE CHAPTER

The purpose of this chapter is to present a comprehensive methodology of innovation best practice in the spatial information industry in Australia. The methodology is intended to serve as a blueprint for the management of innovation for the individual firm. It sets out how a number of factors external to the firm, and relevant to the economy as a whole, could be changed to help foster greater innovation effort in the industry. The methodology takes its form from three primary sources; the review of innovation practice from the world's literature, the five case studies undertaken for this thesis, and the industry-wide survey undertaken of 70 firms in the Australian spatial information industry. The methodology addresses the factors of innovation, the process by which innovation is managed at the level of the firm, factors which impede innovation, and measures of the success of innovation in the firm. In this way the methodology serves as a statement of implications for professional practice in this industry. The chapter addresses the research questions posed by this thesis.

Note: This chapter has been written to be used as a stand-alone document for use by the industry. As a result some of the findings and the discussions from previous chapters have been deliberately included in this chapter to help the user of the methodology make informed decisions based on the practices of peers (and competitors). Moreover new and additional discussion is also included for the same reason. A draft of the chapter has been

reviewed by senior representatives of the industry who are already indicating their desire to see it widely distributed in a form close to that which is included in the thesis.

2.2 INTRODUCTION

The content of the methodology that follows has been built up from the learnings provided by the literature review, the analysis of the case studies and the data supplied by the comprehensive industry survey. One of the over-riding objectives of a best practice methodology of innovation management is that is intended to ***increase*** the likelihood of innovation leading to a successful outcome for the firm. It is clear that this assumes that innovation, to a certain extent, is not a just a random process but one that can be manipulated to for the benefit of the firm. The chapter is underpinned by the finding of the industry-wide survey that seventy-four percent of firms surveyed indicated that they believed innovation was ***critical*** to the success of their firm.

2.3 FACTORS OF THE METHODOLOGY INTERNAL TO THE FIRM AND THE PROCESS FOR THE MANAGEMENT OF INNOVATION IN THE FIRM ITSELF INCLUDING THAT OF THE INDIVUDAL

2.3.1 The process of management of innovation in the firm

The methodology for the best practice of management of innovation in the spatial information industry firm involves a series of factors and other processes that are set out as components in the following sections. The fundamental premise that is established at this point is that firms should make a conscious decision to implement a 'process' made up of the following components, or a subset thereof, commensurate with the needs of the firm.

The process of innovation is stimulated at an early stage through very close contact with customers, generating trust in the working relationship. This engagement yields an early indication of potential opportunities, offers first mover advantage, sets up a fertile environment for prototype testing with reduced risk of loss of client in the event of

failure, and develops a formative relationship that helps secure the client. Feedback loops provide more fodder for additional innovation in a trusted relationship.

Firms like to understand the future needs of customers in order to prioritise innovation plans, to know the activities of their competitors and to understand the emerging technologies. A productive environment needs to be established for the generation of ideas through constant exposure to innovative people from a variety of backgrounds; the spatial information industry, other industries, academia, and so on. Entrepreneurs must be really observant and keep an open mind, constantly scanning the external environment. Strong leadership is needed to establish this environment and this is achieved with a consistent message from the senior management and the innovators. Research can be undertaken to inform the process prior to the development of the innovation itself.

Senior management, acting in their capacity as entrepreneurs, wish to see an early alignment of 'buy-in' from the clients, a clear funding source, a champion, and a marketing and sales plan to cover risk. Once development of the innovation has commenced the process needs iteration, good technical and functional specifications, business planning and sound roadmapping. An early decision is the appointment of the 'champion'. This is normally someone from within the firm although customers even 'lead' innovations as well. An early aim is to develop a sound working demonstration.

Critical to the whole process are the relationships among the innovator (the originators of ideas, the inventors), the researcher (who puts substance to the idea and undertakes development), the entrepreneur (who looks to build new resource combinations) and the capitalist (who has the funds).

Figure 7.3.1.1 illustrates the hierarchical steps a firm can take to progressively improve its ability to drive improvements in innovation. The hierarchy[4] suggests a firm starting out on the innovation journey must first get its time management of people under control,

[4]This hierarchy is based, in part, on the work of Dr Danny Samson, University of Melbourne, presented at a seminar on the results of best practice management in the manufacturing industry in 1996.

quickly followed by its budgets. As the firm begins to free up cash for re-investment it can do so in research and development. The emphasis on quality increases constantly. The firm then begins to customise its products and services. In the spatial information industry customers are increasingly demanding their information products in near real time and while they are mobile (for example a GPS-based map of your location and destination whilst driving the car with the map also showing all the hotels within a 20 km radius) and the top level of the hierarchy illustrates this need.

STEPS IN PROGRESSING THE DEVELOPMENT OF INNOVATION IN THE FIRM

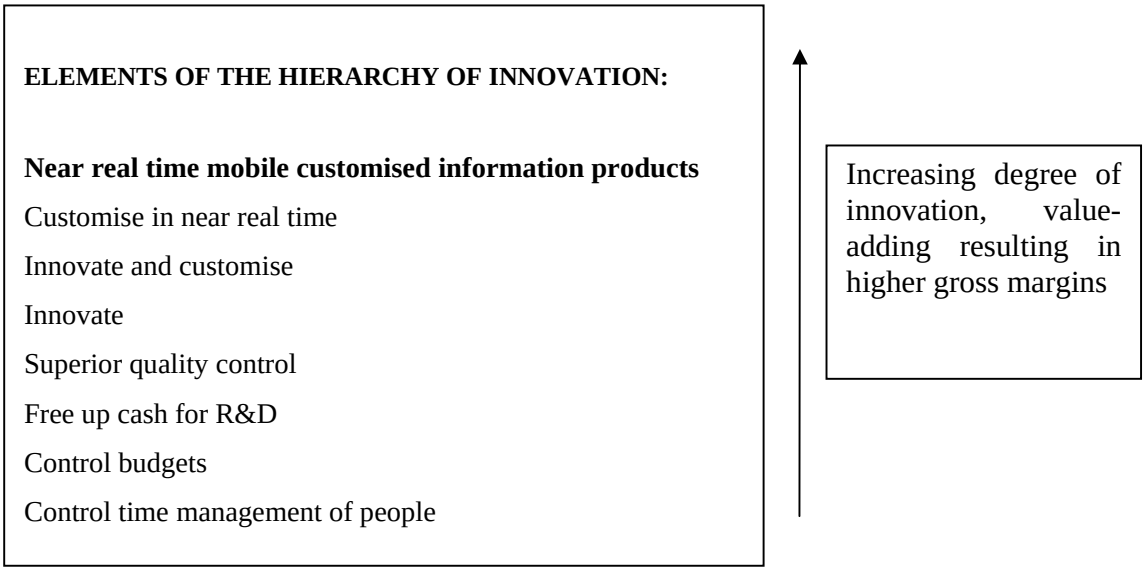

Figure 7.3.1.1 Steps in progressing the development of innovation in the firm**.**

The Figure illustrates *the hierarchical steps a firm can take to progressively improve its ability to drive improvements in innovation. The hierarchy suggests a firm starting out on the innovation journey must first get under control its time management of people, then its budgets. When it begins to free up cash for re-investment in research and development it then begin to customise its products and services. In the spatial*

information industry customers are increasingly demanding their information products in near real time (eg a GPS-based map of your location and destination whilst driving the car with the map also showing all the hotels within a 20 km radius) and the top level of the hierarchy illustrates this need. (This hierarchy is in part based on a chart presented by Dr Danny Samson, University of Melbourne, at a seminar on the results of best practice management in the manufacturing industry in 1996).

2.3.2 Strategic planning

A first order observation would conclude that if the firm is to get larger it should develop a strategic plan and that firm would be wise to include a component that deals with the strategic management of R&D and innovation. This observation is supported by the survey that clearly indicated that the larger the firm the more likely it was to have a strategic plan. Moreover the larger the firm the more likely it was to have referenced innovation and R&D in that plan.

Some of the case study firms used formal strategic planning techniques, such as foresighting and consultants. Others used an annual planning retreat that included the innovators. Strategic planning needs to get the balance of short, medium and long term innovation right. Innovation typically takes several years for the largest projects to get successfully to market. A comprehensive understanding of the cycle of markets helps to get the strategy right.

2.3.3 Level of investment in R&D

The industry-wide survey indicated that the average level of investment in R&D as a percent of total annual turnover was 8 percent. The range for the case studies was from a low of 4 percent to a high of 60 percent. The median figure for the case study firms was 10 percent. Whilst the level of this investment for each firm in any one year is very much dependent on the needs of that firm, it would be prudent to consider an investment that at least matches the industry average of 8 percent. The individual firm would then be well

advised to monitor at least annually the benefits derived from this investment to assess the return on this investment. Given that significant innovation usually has lead times measured in years, this form of commitment must be considered in a strategic context.

2.3.4 Corporate culture

Eight firms in ten agreed that their corporate culture encouraged innovation. Seventy-four percent of respondents were of the view that innovation was critical to the success of their firms. One third of firms (mostly the smaller ones) **do not** have strategic plans and yet many of these are saying that their firm encourages innovation and that it is critical to the success of their firm.

Therefore a significant minority of firms must convey their support for innovation through means other than the strategic plan. Indeed the learnings from this thesis suggest that the desire to establish a corporate culture of innovation is widespread amongst firms. The literature review tells us that firms that encourage innovation in all aspects of their operations have a greater likelihood of success. Firms can create and nurture this culture by many means; the strategic plan, regular and consistent messages from the leadership of the firm, tangible support for initiatives and so on.

All case study firms consciously developed a culture that was very supportive of innovation. Innovators responded by saying they found it stimulating and dynamic, helping make the firm open to new ideas.

2.3.5 Leadership

There was universal agreement amongst the case studies that a firm must have strong leadership from the top to create the innovative environment. Moreover each innovation needs a champion, who may of may not be the innovator, and could be the client. Good stewardship of innovation at all levels in the firm should be strongly encouraged.

2.3.6 Product and service life cycle management[5]

Only twenty percent of those surveyed were from firms that routinely practiced product and service life cycle management ***and*** agreed that it was helpful for the management of innovation. A couple of the case study firms routinely used this form of management, the others did not. The process adds rigour to the management of innovation and development. A number of the case studies complained about the lack of rigour in their management of innovations, singling out timeframes that slipped, poor communication with marketing and sales teams, and poor documentation of software being developed or over-emphasis on the quality management of software development. Whilst firms need to take care that they do not overburden themselves with a bureaucracy that costs more than it contributes, it would appear that there is real scope for a wider adoption of this technique, modified to suit the firm, to help more effectively manage the risks inherent in taking innovations to the market.

2.3.7 Continuous product and service improvement[6]

The process of continuous product and service improvement distinguishes itself from product and service life cycle management by its emphasis on feeding-back to the firm the lessons learnt from its on-going activities. Ninety percent of respondents indicated that their firms routinely practiced continuous improvement and two-thirds said they felt that it was helpful for innovation. Four of the five case study firms used it. The very widespread support indicates that it is an important component of innovation management in particular and the sound management of the firm in general.

---

[5] **Product life cycle management** is the process that designs, plans and implements new ideas from inception through development, marketing sales, further improvement and discontinuation in a formal and well documented way. It has been extensively studied by many authors and Klepper (1996) and Tidd et al (2005) provide a good summary of its relationship to the management of innovation in firms. Its particular strength is its emphasis on the formality of the process which adds to the rigour of management.

[6] **Continuous improvement** implies the employment of a process for learning, feedback and deployment of new knowledge to good intent. The feedback process is further explored by Boer *et al* (2001). These authorrs consider the rather discrete steps in some process that describe new product development (NPD) as being limiting. They develop a more comprehensive process called continuous product innovation (CPI) which is characterised by its continuous learning and feedback in all phases of innovation from genesis, through development, adoption, diffusion and on to routine operational use and ultimately senescence or subsequent value-adding and renewal. In other words CPI also includes all down-stream phases.

2.3.8 Business process re-engineering[7]

Firms are well advised to be mindful that innovation is likely to lead to change in the underlying operation of the firm. When asked if in the development of innovations their company undertakes business process re-engineering, 7 percent of respondents indicated 'frequently', 20 percent indicated 'quite often' and 47 percent indicated 'sometimes'. This tells us that 74 percent of innovations sometimes result in business process re-engineering. The case study firms were mostly ambivalent about its use and used it sometimes.

It would have been more useful perhaps if another question had been put; 'when undertaking business process re-engineering do you take into account the impact on your firms' ability to innovate?' This question deals with the reverse situation, that when change in the management or operation of the firm is proposed has the impact of this change been considered in relation to the impact on innovation. It is the recommendation of this thesis that firms who are considering business process re-engineering should mandatorily consider in the planning of it the potential impact on their firms' ability to manage innovation.

2.3.9 Technology roadmapping[8]

Several of the firms used technology roadmapping and applied it with real rigour. One cautioned that it can be overly bureaucratic and therefore costly to run. It would appear to be one of the newer processes for systematically improving the operation of firms and clearly has potential to play a central role in the management of innovation. Firms involved in regular innovations would be well advised to investigate the potential of this process.

---

[7] Business process re-engineering involves the re-structuring of operations.

[8] Technology roadmapping is a time-based chart, comprising a number of layers (including strategy, innovation, operations and management processes) that typically includes both commercial and technological perspectives. It has several purposes; to identify which new technologies should be brought into existing production processes or service delivery processes, to support strategic planning and long-range planning through a form of environmental scanning (like foresighting), improving the alignment of knowledge-based assets with business objectives, improving project planning, and integrating multiple new technologies into the company. Critically one of the main benefits of technology road mapping is the improvement that it provides to within-company communication.

The issue of the role of the process of technology roadmapping was not considered in the industry-wide survey.

2.3.10 Developing Innovation

A number of key activities have been identified as being of value during the development of innovation. They are: development of a project vision, documentation of the project development system, establishment of project deadlines, specific focus on communication during and throughout the development, and specifically avoiding bureaucracy. The literature review suggests that these activities should be a routine part of the management of innovation projects.

2.3.11 Alliances for the purpose of undertaking R&D

Forty-one percent of firms indicated a preference to conduct their own research rather than doing so through alliances with other organisations. Thirty-one percent preferred to do it with alliances. The case studies all confirmed a strong practice of alliance-making and a reluctance to completely out-source innovation and R&D. The question of whether or not to partner with a third party for innovation should be dependent upon the needs of the firm. This thesis has shown that there is ample evidence that alliances can be very beneficial for firms. The following sub-sections look at four specific instances of alliances.

2.3.11.1 Alliances with Australia's Cooperative Research Centres (CRC's)

Australia's CRC's were identified as the most popular innovation partners for the firms surveyed (47 percent of firms found them helpful). The case studies also confirmed their popularity especially for networking and the quality of the people they attract. CRC's are set up specifically to encourage collaboration with partners drawn from the private, government and research sectors (university, CSIRO and other public research institutions). They have a single over-arching objective and that is to grow Australia's industrial, commercial and economic wealth. They operate as businesses and can provide substantial funds to partnering firms. Intellectual property can be secured by firms for

exploitation in the market. The CRC's are set up to encourage technology transfer and diffusion.

2.3.11.2 Alliances with Australian universities

The survey indicated that 38 percent of firms considered Australia's universities to be helpful innovation partners. These universities can be partners in collaboration in their own right or through the CRC programme, which can facilitate access to the best researchers and help with management of the partnering and commercialisation arrangements.

The case studies indicated that some firms are very happy with close working arrangements with universities. Others noted that the universities can impose costly overheads, that their researchers can be restricted in the time they give due to lecturing commitments, and that the intellectual property constraints imposed by universities can act as a disincentive to sme's.

Much more can be made of the role of universities in collaborative research. Unfortunately Australia's universities do not have a strong reward mechanism to encourage individual researchers to participate in speculative research with sme's. There would need to be changes to the criteria for promotion for this to change. Moreover governments would need to change the funding formulas to universities to reward them for greater engagement with sme's. This is a potentially serious loss of research opportunities because the latent potential of Australia's 39 universities is huge in this regard.

2.3.11.3 Overseas research organisations

Twenty-three percent of responding firms indicated that they felt overseas research organisations are helpful alliance partners. Australia's universities also have generally very good networks with overseas research organisations and these networks are almost certainly able to be much better exploited by Australian firms. The technology that

underpins the spatial information industry is mostly developed overseas (eg satellite systems, aircraft-based imaging systems, the large software processing systems and so on). Conversely Australia is data and information rich and it is the combination of the technology, data and know-how that provides the greatest market advantage. This equation may work best for many firms when the overseas connections are well established.

2.3.11.4 CSIRO

This was the least popular alliance partner (18 percent considered them helpful). CSIRO (the Commonwealth Scientific and Industrial Research Organisation) in Australia's largest publicly (part funded) research agency with over 6000 employees. It has a mandate to undertake practical research. The fact that it is not a preferred partner is a concern, especially given its well-developed expertise in the spatial information sciences. Insights into this situation were given during the case studies. One firm (ANU) cited an example of CSIRO actively competing with the private sector. Another viewed them as being overly bureaucratic. Yet another stated that it had little idea how to go about cultivating a relationship with them. On the other hand there was acknowledgement that CSIRO had scientists of high caliber.

CSIRO should not be disregarded as a potential partner. Further investigation of this problem is warranted.

2.3.12 Recruitment

Only 68 percent of respondents indicated that they use the 'ability to be innovative' as a criterion when recruiting new employees. Two of the case study firms routinely used the criterion. If firms choose to accept the proposition, as recommended in this thesis, that innovation pervades every aspect of the business, then it is a relatively simple matter to include this criterion when recruiting to each position in the firm. Furthermore, the firm will become more adept at judging the quality of the innovation skills of potential employees the more it uses the criterion.

2.3.13 Marketing scanning and business case development

Sixty-one percent of firms undertake a comprehensive scan of the market before committing to further development of innovation. Unless the firm has a guaranteed client for the innovation, the firm is exposing itself to risk, the magnitude of which is determined by the potential loss. Moreover, only 58 percent of firms work up a comprehensive business case before committing to further development. As we have previously seen, some firms feel that they do not apply enough rigour in the management of innovation. Lack of desire to work up a business case adds to this lack of rigour and compounds the risk. In the process of managing innovation the firm should consider a formal project management approach to innovation that includes market scans and business case development.

2.3.14 Benchmarking the management of innovation

Only 29 percent of firms benchmark their management of innovation against other firms. It was an infrequent activity amongst the case study firms as well. Periodic benchmarking offers the advantage of monitoring continuous improvement. It can become a part of the process of innovation management.

2.3.15 Incentives for individual innovators

Respondents considered a range of factors that could be used to motivate individual innovators. In decreasing order of value (based on the number of responses) they were:

- **Intrinsic motivation (fun, the challenge, the sense of achievement' etc)**
- **Freedom at work**
- Promotion
- Remuneration
- Profit sharing
- Being singled out for recognition in reports, newsletters, etc
- Bonuses

- Share options
- Added responsibilities
- Awards

The top two in bold were twice as popular as the others amongst respondent firms.

This was broadly supported by the case study firms. One case study firm gave their innovators their own time, space and appropriate resources. It maintained an open door policy to senior management and a diversity of activities across the firm in order to nurture the interest of innovators. The same firm noted that senior management had a good ability to judge who should be innovators and how much time each should be given for exploratory activities.

Other firms offered trips to Queensland (!) as an incentive, encouraged membership in professional organisations, paid conference attendance, regularly placed innovation topics on meeting agendas (internal and external), personnel working from home, and 'pandering to other whimsical needs'. Intangible incentives identified by firms included helping the innovators do something 'cool' and to do it before any one does, and to applaud the simple 'joy of seeing ideas come to fruition'.

The case studies also noted that senior management needs to be good at judging who makes a good innovator and how much flexible time to offer them. They suggested mentoring and ensuring the innovators have the backing of their peers, and a senior management that is not too distant.

2.3.16 Personal qualities of innovators

Respondents considered a range of personal qualities in terms of their ability to influence innovation. They were in decreasing order of support:

- **Initiative**
- **Attitude**

EXTRACTS FROM PETER WOODGATE'S DOCTORATE OF BUSINESS ADMINISTRATION THESIS, RMIT UNIVERSITY, NOVEMBER 2007

- **Personal creativity and lateral thinking**
- **Persistence**
- Curiosity
- Knowledge
- Opportunism
- Fascination for solving problems
- Technical skills
- Prior track record of innovation
- Willingness to ask questions
- Thirst for knowledge
- Age

The top four in bold were demonstrably better supported than the rest by both the survey and the case studies. In recruiting for innovators, these could be the qualities which are preferentially selected. In skilling-up existing employees these are the qualities which can be nurtured by additional training – to the extent that this is possible.

Additional qualities that the case studies identified were:

- very strong self-belief and optimism
- an intrinsic motivation just by being an innovator
- a degree of eccentricity (noting that innovators can be a little difficult to work with)
- shy of discipline
- a degree of cynicism
- good at problem solving
- recognition that innovative ability may be something that is 'in the genes'
- a loathing of failure but little fear of it
- strong desire to learn

It is clear that there is no single profile for a great innovator. The last word on this issue is best given to one of the CEO's who said that his best innovators possessed an infectious enthusiasm and an ability to see into the future.

2.3.17 Qualifications of innovations

As a general rule the more qualified the individual the more innovative they are likely to be in their area of expertise, especially where complex technologies are involved. However a number of the case study firms said that they had no fixed ideas about the level of qualifications and noted that they did have innovators who had no formal qualifications. Other firms employed innovators who were qualified right up to PhD level. Most did note that the innovators have to have a certain level of spatial technology knowledge and that an appropriate qualification was the easiest way to ensure that this was so. The usual recruiting process for most firms, tests for formal technical skills and this continues to be most appropriate.

2.3.18 Making Innovators accountable

All of the case study firms indicated that it was difficult to make innovators accountable, especially in working to budgets and timelines. It was observed, however, that the best innovators do seem to work quickly. Clearly the firm needs to justify outcomes and to review milestones on a regular basis. This assumes that a sound project plan and, or, business plan is already in place. It is up to the champion of the innovation to argue for continuing support from milestone to milestone. The key is to make innovators accept responsibility and to help them understand the context of their work. Operating innovation and R&D as discrete projects was a well supported approach. Two firms asked their innovators to make themselves accountable to both Executive management and the Board, especially when working in new start-up spin-off companies. Managing the innovators to the principle of 'loose expectations' and 'authority with responsibility', monitored against the bottom line of the firm, seemed a fair summary of best practice.

2.3.19 Structure of the firm

The case study firms operated a combination of a matrix and a divisional approach based on geography and function. All of the case study firms supported the use of a dual ladder[9], however one of them was not currently applying it due to budgetary constraints. A dual ladder would appear to be a sound mechanism for motivating and managing innovators and it is the recommendation of this research that firms adopt this approach.

2.3.20 Adoption and diffusion of ideas

It is useful to summarise the performance of each case study firm in relation to significant innovations (loosely defined in this thesis as innovations with discrete budgets that are easily identified as stand-alone initiatives) brought to market:

ANU: over the last five years probably had a pool of hundred's of ideas, with around 5 to 10 being brought to market in that time, and approximately 1 to 3 per annum.

DAMONA: had a pool of about 10 to 12 ideas and got about 1 to 2 to market in five years. This represents a rate of about one innovation every one to two years.

CORRA: Not sure of the size of the initial pool, with 5 to 10 to market over 5 years (representing a 60 percent failure rate for those innovations that were started). This represents a rate of one to two every year.

ESUS: Not sure of the size of the initial pool, with 3 major innovations to market in 17 years. This represents a rate of about one innovation every five to six years.

LATIS: an initial pool of around a 100 ideas with 6 to 8 brought to market in 5 years, and 2 to 3 in last two years. This represents a rate of a little over one per year.

[9] A dual ladder is a promotional structure that comprises both the typical hierarchy based on increasing seniority of management, plus a dual stream allowing non-managers (the innovators) to receive salary increases on the basis of their innovative (and or R&D) abilities.

So the rates of adoption and diffusion for significant innovations range from a low of one every five to six years to a high of one in less than one year. It would be even more useful if it were possible to compare the expected timing to market, estimated at the outset of the development of the innovation, with the actual timing. That is beyond the scope of this research .

2.3.21 Relationship between the CEO and Innovators in the firm

The case studies raised several examples where the CEO and innovator gave different answers to questions of fact. Examples included firms where:

- The CEO had not involved the Innovator in the development of the Strategic Plan hence when asked by this thesis the Innovator stated that firm did not have a strategic plan when in fact it did.

- The CEO and Innovator recalled incorrectly the content of the strategic plan with respect to R&D and innovation, and both recalled its general contents incorrectly (and in fact differently as well).

- In another instance the CEO said that they did not practice technology roadmapping and Innovator said they did.

These forms of confusion on issues of important fact can easily lead to a diminishing of the quality of the innovation in a firm. It is clear from these examples are that there is a need to have a strong and consistent message of innovation, and frequent formal and informal communication between the CEO and the Innovator. This applies to developing common understandings of the strategic plan, the business plans, the structure of the organisation and training programs, and the attitude and actions of the leadership of the firm and those of the innovators.

2.4 FACTORS OF THE METHODOLOGY OF INNOVATION EXTERNAL TO THE FIRM

2.4.1 Government policies at Federal, State and Territory level

2.4.1.1 Finding out about government support programs for Australian firms

Sixty-four percent of industry survey respondents indicated that they felt that the time and effort taken to find out about government support programs was an impediment to innovation in their firms. This is a clear majority of firms and suggests that action needs to be taken to make it substantially easier and quicker for firms to find out about these programs.

2.4.1.2 General policies of the Australian government

There was no strong and widespread feeling that the current policies were fundamentally wrong, with only thirty percent of surveyed firms stating that the policies of the Australian government were critical to the their firm's ability to be innovative. One case study firm observed that business-friendly policies from government could be the catalyst for significant innovation in industry if government chose to do so.

2.4.1.3 General policies of the State governments

Forty-four percent of respondents were of the view that the policies and programs of state governments operated to impede innovation in their firms (eg labour laws). This is a significant minority of firms. One of the case studies noted that the state governments hold large amounts of data which could be increasingly value-added for the market if licencing arrangements could be streamlined. Another felt that states could make a contribution to innovation by reducing their interstate rivalry, a rivalry that leads to non-uniformity of effort for firms trading interstate.

2.4.1.4 Australia – United States Free Trade Agreement

Two firms expressed concern about the potential of the agreement to generate time consuming and vexatious litigation associated with intellectual property. This may serve to be a cautionary note for the future.

2.4.1.5 Export incentive schemes

Some firms have already observed a looming saturation of domestic markets and have strategically positioned themselves to grow overseas. Therefore the issue of export incentives is likely to be increasingly important over the next decade. There was a general feeling that the current government programs were not as helpful as the majority of the firms would wish them to be. One of the case study firms found that AusIndustry was too bound up in red tape. The same firm had also sought to use AUSTRADE and found it poorly attuned to the needs of sme's. Another firm wished to see an increase in export incentives. These are issues that need to be taken up separately with relevant government bodies to determine the veracity of these observations and to suggest appropriate actions if found to be true.

2.4.1.6 R&D Tax rebates

There was no widespread support amongst surveyed firms to for a change in the current level of tax rebates.

On of the CEO's from the case study firms mused about the possibility of introducing an R&D tax levee, coupled with elimination of R&D tax concession and a reduction in company tax, if the firm decided to invest more in R&D. These thoughts require much additional development before they can be taken further.

2.4.1.7 Privacy and security legislation

Most firms have no strong feelings about a future negative impact of privacy and security legislation. It appears not to be a significant factor from the point of view of the management of innovation at this time.

2.4.1.8 Australian Research Council Grants

Only 16 percent of respondents agreed that the Australian Research Council (ARC) grants were helpful in promoting innovation in their firm. The case study firms were generally of the same opinion. Taken overall this is a low level of support reflects poorly on this form of industry support.

The ARC operate a program called 'Linkage' grants that is designed to encourage firms to partner with universities on collaborative research. Some of the case study firms commented that the program in theory sounded good but that they had tried without success to obtain funding from it. The biggest draw-back therefore seems to be the limited reach of the ARC grants in relation to the vast majority of firms.

2.4.1.9 AusIndustry Grants

Twenty-seven percent of firms surveyed agreed that AusIndustry grants were helpful to their firm's ability to innovate. The case study firms also confirmed these findings. These grants are specifically designed to help firms innovate, commercialise and access venture capital. The survey indicated that they are better supported than the ARC grants but at 27 percent the level of support is still relatively low.

2.4.2 The availability of early seed funding or private equity

Thirty-six percent of respondents agreed that the lack of early phase seed funding was an impediment to innovation, but 27 percent said that it was not. The rest were indifferent. Some of the case study firms expressed the view that they would like to see a greater availability of this form of funding. A minority of firms therefore are affected but it does not appear to be a significant issue at present.

2.4.3 Australia's culture

The case study firms made a number of observations about Australia's culture and its impact on innovation:

- Several CEO's said they were disinterested in the issue
- One CEO said that his firm's innovation was not driven by Australia's culture
- Two CEO's said that they felt the culture was too conservative and therefore acted to dampen spending on innovation and research in the economy generally, especially in the public sector, but he predicted that the next generation of governments would be more entrepreneurial.
- Another Innovator was very interested in the views of the 'Y' generation because he felt they would really shape future markets.
- One CEO wanted a culture change that saw Australian firms investing more in R&D.
- One CEO was unsure about the culture but wanted to see more general enthusiasm for 'blue sky' research.
- An Innovator felt Australia did not have a 'tall poppy syndrome' and that the country had a healthy innovation culture.
- One CEO preferred that a 'buy Australia' mentality be re-cultivated.

The general feeling was that Australia's culture could be more conducive to innovation but that it was not generally operating to be a significant impediment to innovation.

2.4.4 Innovation Parks, Centres of Excellence and similar

Several of the case study firms expressed support for the concept but the overall impression was one characterised by a lack of strong views.

2.4.5 Expansion of the broadband and wireless networks

A majority of firms (58 percent) agreed that an expansion of the broadband and wireless networks would enhance innovation in their firms. Most of the case study firms were very supportive of this development with one stating that it was likely to be the single most significant development that could occur in the industry over the next few years.

Much of the spatial information industry relies heavily on the flow of large volumes of data and information. Spatial information is particularly bandwidth-hungry by its very nature. Moreover the industry is feeling significant pressure to deliver more information in near-real time. Thus it is not surprising that the industry is supportive of this mechanism that promises to speed up deliveries of data and information. Influencing these developments is largely out of the hands of the spatial information industry and of government. However the industry can make its case to the telecommunications companies, possibly through ASIBA.

2.4.6 Skills levels of staff

On the issue of entrepreneurship skills; 80 percent of respondents indicated that they felt there was a greater role for universities in providing graduates with more entrepreneurial skills because only 43 percent of firms indicated that they felt the staff in their firm have sufficient entrepreneurial skills. Several of the case study firms agreed with these findings. Entrepreneurship involves adding value, increasing markets, and adding customers to the business, whilst innovation involves creating something new (that is of use) for the business. The entrepreneur is required to harness the outputs of the innovation. Individual firms would be well advised to examine if they have the right level of entrepreneurial skills and if not to seek to up-grade the skill level of existing staff or recruit new staff.

On the issue of R&D skills; only 25 percent of firms felt that recent university graduates have sufficient training in R&D for the needs of their firm.

The case studies also made several other suggestions; that graduates could have better appreciation of the commercial skills needed by firms, that leadership skills were lacking, and that graduates are not sufficiently taught business skills (ie are not familiar enough with business planning and profit and loss statements, balance sheets, and cash flow reports).

These findings suggest that Australia's universities could give thought to re-working their programs at undergraduate, post-graduate or short course levels to help overcome these deficiencies.

2.5 FACTORS THAT IMPEDE INNOVATION

Respondents considered a list of potential impediments. In descending order of significance they were:

- **Lack of skilled people**
- **Excessive time lags in developing innovative ideas**
- **Poorly managed criteria for identifying successful innovation (success hurdles)**
- **Lack of knowledge of customer requirements**
- **Lack of knowledge about technology developments**
- **Chasing too many ideas at once**
- Inability to fully harness the resources of universities
- Concern over risk taking
- Lack of attention to quality

Those factors shown in bold had more than 50 percent of those surveyed saying they were significant impediments to their firm.

Interestingly in relation to the 'overseas brain drain' only 21 percent of respondents felt it was an impediment. So while the skills shortage could be mildly exacerbated by the overseas brain drain the skills shortage appears not be seen to be responsible for it. Moreover addressing the 'overseas brain drain' is unlikely to overcome the problem of lack of skilled people. One case study firm noted that a number of their staff had resigned to go overseas and then come back to work for the firm better skilled and more experienced.

EXTRACTS FROM PETER WOODGATE'S DOCTORATE OF BUSINESS ADMINISTRATION THESIS, RMIT UNIVERSITY, NOVEMBER 2007

There were other observations about impediments to innovation from the case study firms:

- The lack of 'smart' people was a limiting factor.
- Long lead times were noted before good outcomes were achieved (up to 3 – 5 years).
- Operating a policy of precluding innovators from owning some of the IP was an impediment to innovation.
- Individual innovators who did not understand the role of R&D sufficiently, preferring to concentrate on the D and neglect the R.
- Innovators did not have a good enough understanding of the business drivers.
- Management were not adequately skilled to manage innovation.
- Some entrepreneurs suffered from self doubt in relation to investing in potential innovations.
- Businesses lacked sufficient contacts to identify new opportunities.
- Lack of ubiquitously high speed lines (10 mbits per sec) impeded some innovations.
- Lack of market awareness of the possibilities for spatial information solutions impeded innovations growing into new markets.
- Some employees were stubbornly resistant to change including that which went with innovation.
- Poor communication within the clients organisation and too few champions within the client organisation impeded innovation.
- Capital gains tax operated as a disincentive to investment in innovation.
- The high level of business regulation was an impediment.
- There was a generally low risk approach to business because Australia has relied for too long on the ready available of income derived from the

exploitation of primary produce (for example mining and agriculture) and the country is therefore not as well prepared for undertaking more 'blue sky' research as it should be.

- The length of time it can take to do a sound due diligence on a good innovation can an inhibiting factor.
- Competition for resources in the firm reduces resources for innovation activities.
- Poor synchronization of the time it takes to bring together the customers, suppliers of technology and their related data and information, and development partner can be an impediment.
- Competition from the daily workings of the firm most of which are not concerned with innovation acts as impediment.
- Inertia in the firm, especially if it is a firm with a well-established software product that needs to be kept stable in its production, can impede innovation.

These factors serve as a check list of issues that should be taken into account when planning innovation.

2.5.1 Intellectual property issues

One significant intellectual property issue was raised by one of the case study firms and that was the propensity in recent years for clients to seek ownership of the new and underlying intellectual property in their contracts. This intellectual property was previously left in the ownership of the firm for them to value-add and re-use in the market. This was having a detrimental effect on their innovation.

This development is widespread and unlikely to change.

2.6 MEASURES OF THE SUCCESS OF INNOVATION IN THE FIRM

There was strong consensus among the case study firms that the ultimate measure of the success of the innovation was its impact on the bottom line. Surveys of the views of clients were also found to useful. Interim measures included the quality of financial management. It certainly appears that the development of the ideas that leads to innovation is the easier part and exploitation the harder part.

The literature review identified a number of other issues that can be used to help form measures of success that were not raised by the firms. Firstly at the level of the firm:

- build in feedback from results to expectations for each innovation project
- develop a systematic review of the total innovation effort of the firm and decide how to manage the need to change the resourcing as result
- undertake an external scan of the overall innovation effort of the firm and the market and compare this to the firm's overall performance the number of ideas generated
- count the number of patents filed
- count the number of scientific papers published
- count the number of new products introduced
- bottom line measures of innovation can be based on investments in R&D and have the advantage of offering a quantitative method for evaluating R&D. They include the following formula which states that the effectiveness of the investment in R&D can be measured as a ratio of the multiple of the new product (or service) revenue multiplied by the sum of the net profit and the investment in R&D as a percentage of all revenues:

$$\text{R\&D effectiveness} = \frac{\%\text{New product revenue} \times (\text{Net profit}\% + \text{investment R \&D}\% \text{ of all revenues})}{\text{R\&D}\%}$$

…and if > 1.0 then return has exceeded investment.

And at the level of the economy:

- Innovation drivers (inputs): year 12 school graduates per 1000 population aged 20 - 29, population with tertiary education aged 25 – 64 per 100 population, broadband penetration rate (number of lines per 100 population), participation in life-long learning per 100 population aged 25 – 64
- Knowledge creation (inputs): public and business R&D expenditures as a percentage of GDP, share of medium and high high-tech R&D as a percentage of all R&D expenditure, share of university R&D expenditures financed by business sector
- Innovation and entrepreneurship (inputs): sme's innovating in-house as a percentage of all sme's, innovative sme's co-operating with others as a percentage of all sme's, innovation expenditures as a percentage of total turnover, ICT expenditures as a percentage of GDP
- Application (output): employment in high-tech services as a percentage of total workforce, exports of high-tech products as a share of total exports, sales of new-to-market products as a percentage of total turnover
- Intellectual property (output): patents per million population, new community trademarks per million population, new community designs per million population

The best measure is the firms' bottom line and the challenge is to find incontrovertible links between this and innovation.

2.7 CONCLUSION

The methodology, or blueprint, of management best practice for innovation in the spatial information industry in Australia has been constructed to provide practical guidance to managers of innovation in Australia firms. It distills the findings of the literature review, case studies and industry-wide survey. It is commended for use by industry.