A New Model of Entrepreneurship with Entrepreneurial Leadership Capacity (EELC) for High-Technology Ventures: A Biotechnology Industry Application

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CERTIFICATION

This thesis is submitted in fulfilment of the requirements of the degree of PhD, in the Graduate School of Management, Macquarie University. This represents the original work and contribution of the author, except as acknowledged by general and specific references.

I hereby certify that this has not been submitted for a higher degree to any other university or institution.

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ABSTRACT

High-technology entrepreneurship for new ventures in emerging economies has taken a critical role in the creation and growth of economies. There is a strong demand for a fresh approach to the study of entrepreneurship in high-technology industry due to the unique nature of its research and development for innovative products.

This thesis proposes a different approach, where a model of entrepreneurship with entrepreneurial leadership capacity (EELC) for high-technology ventures is used to enhance the pursuit of modes of entrepreneurial exploitation within good business models and enterprise performance. By including entrepreneurial leadership capacity (ELC) in the entrepreneurial process, it is proposed that there would be a higher chance for successful ventures. In the EELC model, the independent variables include entrepreneurial type (PA, EI, SS and RM), market orientation, business climate, environmental uncertainty, competitive advantage, and organisational strategy, while the dependent variables comprise presence of opportunity, opportunity recognition, decision for opportunity exploitation, resource acquisition, process management, business models and enterprise performance. It is proposed that independent variables will act on dependent variables only indirectly via an intervening variable that has entrepreneurial leadership capacity (ELC) as the mediator.

The EELC model was applied to the high-technology industry, in this case the biotechnology industry, to validate its findings. The survey data was analysed statistically by using Partial Least Squares Path Modeling (PLS-PM) for Structural Equation Modeling (SEM).

It was found that entrepreneurial type and market orientation were the two important drivers affecting the entrepreneurial leadership capacity and the

entrepreneurial process. The role of ELC as the mediator is confirmed to be critical to enhancing the pursuit of modes of entrepreneurial exploitation in the presence of opportunity.

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Acronyms

BFMPT	Big Five model of personality traits
CB	Corporate branch
EELC	Model of Entrepreneurship with Entrepreneurial Leadership Capacity (EELC)
EI	Expert idea generator
EL	Entrepreneurial leadership
ELC	Entrepreneurial leadership capacity
FWPT	Four-way psychological typology
GRSO	Government research institute/department spin-off
ISO	Industrial spin-off
IV	Independent venture
NEL	Non-entrepreneurial leadership
PA	Personal achiever
PI	Private investor + university collaboration
PLS	Partial Least Squares
PLS-PM	Partial Least Squares Path Modelling
PLS-SEM	Partial Least Square Structural Equation Modelling
RM	Real manager
SEM	Structural Equation Modelling
SS	Super sale people
USO	University spin-off

CHAPTER 1 INTRODUCTION

1.1 Chapter Introduction

This chapter presents the introduction to the thesis. It starts with an introduction to the research background and identifying the research area. This is followed by the related theories/frameworks being used for research and the research questions. Research methodology, an outline of the thesis and delimitations of scope and key assumptions are presented. At the end of the chapter is a summary.

1.2 Background to the Research

The significance of entrepreneurship has been recognised and widely studied as one of the driving forces both in improving the economy and in the creation of wealth and jobs (OECD 1998). High-technology entrepreneurship for new ventures in emerging economies has also taken a critical role in the creation and growth of economies (Siqueira & Bruton 2010). Biotechnology industry is one of the most significant industries in high-technology entrepreneurship (Menrad 2000).

Entrepreneur

The term "entrepreneur" is derived from the French language - specifically the two words "entre" meaning "between" and "preneur" meaning "taker" (Kuratko & Hodgetts 2007). The verb is "entreprendre" which means "undertake". In English it means "organise, manage and assume the risks of a business". Generally an entrepreneur is an individual who manages and organises labour, technology and resources to produce goods and services for profit generation, but with a risk of failure. In this thesis, the adopted definition of entrepreneur is

> "an innovator or developer who recognises and seizes opportunities; converts these opportunities into workable or marketable ideas, adds value

> through time, effort, money or skills, assumes the risks of the competitive marketplace to implement these ideas; and realises the rewards from these efforts" (Kuratko & Hodgetts 2007).

The definition adopted here is the main focus for this thesis. When entrepreneurs exploit the opportunities in high-technology in the biotechnology industry, they are also described as bioentrepreneurs. Entrepreneurship applied in biotechnology is referred to as bioentrepreneurship (Lynskey 2004; Muller, Fujiwara & Herstatt 2004; Meyers & Hurley 2008; Patzelt & Brenner 2008).

Entrepreneurship Research

In the literature, extensive themes or topics for entrepreneurship research have been proposed and studied for more solid theory building (Ucbasaran, Westhead & Wright 2001; Busenitz, West III, Shepherd, Nelson, Chandler & Zacharakis 2003). Gregoire, Noel, Dery and Bechard (2006) classify seven conceptual convergence areas in entrepreneurship research. These are: identification and exploitation of opportunities (Kirzner 1973, 1997; Ardichvili, Cardozo & Ray 2003; Short, Ketchen, Shook & Ireland 2010), characteristics of individual entrepreneur (Hornaday 1971; Gartner 1989; Littunen 2000), dynamics of the emerging venture (Schumpeter 1943; Barney 1991; Barney, Wright & Ketchen Jr 2001), behaviours of firms (Schumpeter 1934; Lumpkin & Dess 1996), factors influencing the dynamics of new venture performance (Sandberg & Hoffer 1987), venture capital (MacMillan, Siegel & Narasimha 1985; MacMillan, Zemann & Subbanarasimha 1987; Butler, Lockett & Ucbasaran 2006) and social capital and social network (Birley 1985; Watson 2007; Slotte-Kock & Coviello 2010).

Although these seven conceptual convergence areas in entrepreneurship research have provided a reasonable basis for building the entrepreneurship theory, there is still strong demand for establishing a distinctive theory of entrepreneurship and better conceptual framework development (Shane & Venkataraman 2000; Morris, Kuratko & Schindehutte 2001; Phan 2004). Increasingly, more researchers admit that entrepreneurship is an eclectic phenomenon (Ireland & Webb 2007a). Because of this specific nature, entrepreneurship scholars should draw from multiple disciplines, methods and theories—for example, economics, sociology, psychology, leadership, strategic management and anthropology—in studying the questions related to individual-, firm-, and society-level effects of entrepreneurship (Ireland & Webb 2007a). In addition to cross-disciplinary collaborations, Phan (2004) has also suggested an holistic and co-evolutionary approach that will involve multilevel theories on investigating the emerging phenomenon, even at lower levels of analyses, for finding additional knowledge about entrepreneurship.

Based on the requirements for cross-disciplinary, multilevel and holistic criteria, researchers have suggested an integrative approach for entrepreneurship research which will handle the multidimensional process involving the environment, organisations and individuals (Bell, McNaughton, Young & Crick 2003; Guo 2006; Morris et al. 2001). In the literature there has been little on the integrative model of entrepreneurship, although Guo (2006) proposes the integrative model to be applied to entrepreneurship management in health services. His integrative approach for entrepreneurial management processes can enhance organisational viability by identifying the roles of managers for the determination of appropriate entrepreneurial strategies that are relevant for the current health care environment. This thesis adopts the integrative approach for constructing a new model of entrepreneurship.

In the past, scholars agreed that leadership and entrepreneurship should be treated as two separate disciplines (Gupta, MacMillan & Surie 2004). As the failure rate of new ventures increased rapidly, more entrepreneurs realised the necessity of having effective leadership behaviour as a necessary component for success (Gupta, MacMillan & Surie 2004). This led to more attention being paid to leadership in the entrepreneurship literature (Cogliser & Brigham 2004; Vecchio 2003). Darling, Gabrielsson & Seristo (2007, p. 19) says “The entrepreneurs who provide leadership in addition to merely managing their enterprises are the ones who have a higher potential for success”. This demonstrates the importance of management leadership in an organisation and entrepreneurial leadership in new ventures by entrepreneurs. In addition, the chance that entrepreneurs will exploit the opportunities will depend on the difference between the low or high opportunity cost and alternative uses of the time (Shane 2003). The difference will be increased by factors such as the availability of information and availability of skills from high level of education and career experience, having a working spouse for uncertainty reduction, and mature or middle age with a strong social position of accumulated wealth of information (Shane 2003). Entrepreneurs with the availability of information and availability of entrepreneurial leadership skills will have the best chance to exploit entrepreneurial opportunities for ventures.

Entrepreneurial Leadership and Entrepreneurial Leadership Capacity

Entrepreneurial leadership is a new area for research between the disciplines of entrepreneurship and leadership. In this thesis, the adopted definition of entrepreneurial leadership is that of Hitt, Ireland and Hoskisson (2001): “the entrepreneur’s ability to anticipate, envision, maintain flexibility, think strategically, and work with others to initiate changes that will create a viable future for the organisation”. Entrepreneurial leadership capacity possessed by an entrepreneurial type plays the critical role in pursuing modes of exploitation in high-technology ventures in particular of biotechnology.

High-Technology Ventures

High-technology is defined as the trade in exports and imports of products requiring extensive research and development (R&D) in their development and/or production (Loschky 2009). As not all goods produced by high-tech industries are also high-tech products, two different approaches exist for the calculation of high-tech trade indicators. These two approached are: the product approach and the sectoral approach (OECD 2005). According to this classification, the product approach covers the trade of high-technology products while the second approach covers the trade of goods by high-technology industries. The five high-technology industries and nine high-technology product groups are shown in Table 1.1 (Loschky 2009, p. 6):

Table 1.1 Classification of high-technology industry and product groups

High-technology industries (sectoral approach)	High-technology product groups (product approach)
1. Aerospace 2. Pharmaceutical/biotechnology 3. Computers, office equipment 4. Electronics-communication 5. Precision instruments	1. Aerospace 2. Computers and office machines 3.Electronics and telecommunication products 4. Pharmaceutical products 5. Scientific instruments 6. Electrical machinery 7. Chemical products 8. Non-electrical machinery 9. Armaments

Source: Adapted from Loschky (2009, p. 6)

Typically, high-technology ventures operate in an environment that is under constant change. Consequently, firms need to continually invest in technology to remain competitive (Wernerfelt 1984). According to Foss and Ishikawa's (2007) dynamic resource-based perspective, and the Austrian school of economics, entrepreneurship characterised by judgment is defined as decision-making under conditions of uncertainty. Entrepreneurs create value by making judgments about the optimal combination of resources. As a result, determining how much to allocate to technology investment is one of the key decisions of the entrepreneur in a high-technology venture. However, technology resources are crucial for firms to create wealth, by enabling firms to create value for customers (Sirmon, Hitt & Ireland 2007) and to develop competitive advantage (Grant 1991). Technology investment can take various forms, including expenditures on new buildings, equipment, or development (R&D. By spending on installations and equipment, high-technology firms can improve their operational capacity not only to develop new products and services, but also to produce goods and services to meet market opportunities. The expectation is that this type of technology investment will lead to greater performance among high-technology firms in developed and emerging economies (Siqueira & Bruton 2010).

In the sectoral approach in Table 1.1, biotechnology is considered one of the high-technology industries. In the research for a new model for entrepreneurship, the biotechnology industry is chosen to test the new model in this study due to its significance to wealth creation, economic development and advancement of technology in society. The biotechnology is one of the most significant industries in high-technology entrepreneurship because of its technology intensive, knowledge based, and risk-prone existence in a dynamic environment.

Biotechnology Industry

Since biotechnology is considered as one of the important high-technology ventures, the following section will be devoted to discussing the biotechnology industry in more detail as the background of research.

After the "information age", high-technology such as biotechnology is being considered as the next revolution that will have a profound effect on all aspects of society (Menrad 2000). The knowledge base for biotechnology has expanded enormously over the past two decades, as the number of biotechnology companies has increased (Oliver 2004). This expansion may be accounted for by the worldwide investment in biomedical research for the improvement of human health. Biotechnology has emerged as a key technology for the acceleration of economic development due its potential for the creation of new products and processes, the increase of productivity in existing industries, the stimulated demand for skilful work forces and job creation (Menrad 2000). This justifies this thesis's focus on the biotechnology industry to ensure its entrepreneurial nature may be more appropriately for improved sustainability of businesses.

The traditional entrepreneurial model has been suggested as appropriate to evaluate life science ventures such as biotechnology, while a more modern entrepreneurial model from information technology (IT) may also be borrowed to develop biotechnology ventures. Realistically, the entrepreneurial model of IT cannot be exactly transferred for adoption by the biotechnology industry. There are many differences between entrepreneurship in IT and biotechnology industries (Hine & Kapeleris 2006). In the IT industry, the product life cycles are around six to twelve months. The R&D period is normally quite short, with limited resource requirements such as labour and overhead costs for software and hardware. Most IT start-ups only need to source capital funding in the initial product launch but not throughout the venture (Hine & Kapeleris 2006). Since the IT market changes so fast that regulation may not be able to keep up with it, corporate governance derives mainly from internal regulation. It is quite difficult to maintain intellectual property (IP) control in the IT industry. Design copyright is quite dominant in the IT industry, together with a focus on patents and trademarks.

In contrast, the product cycles in the biotechnology industry are medium to long term (Hine & Kapeleris 2006). The R&D period can range between five and fifteen years depending on the developmental stages and the type of products. Capital sourcing is constantly part of the activity of bioentrepreneurs because of the capital-intensive nature of extensive sunk costs. Since the biotechnology market is highly controlled with extensive regulation, this severely impacts on the product development process. It is also essential to control the intellectual property in order to ensure the success of major biotechnology companies, and this has created substantial financial burdens for biotechnology companies. There are more patents than trademarks, but little design copyright, in the biotechnology industry because of the protection of confidentiality (Hine & Kapeleris 2006). From the above comparison of both industries, it is clear that the biotechnology industry cannot blindly copy the entrepreneurial model of the IT industry as an appropriate roadmap to pursue bioentrepreneurial ventures.

Friedman (2004) also comments on the other special features of the biotechnology industry. "The knowledge-based, research-intensive nature of biotechnology companies gives them unique characteristics… Biotechnology companies must find a balance of resource allocation that combines a strong scientific base, sufficient financing, and relevant business expertise." (Friedman 2004).

The major challenges of the biotechnology industry arise from its special nature as a science-based business. These are the fundamental clash of norms, values and practices between the science and business worlds; the difficulty in financing highly risky investments under persistent uncertainty and prolonged R&D product development, and identifying the appropriate way to capture the capabilities across the broad spectrum of scientific and technological knowledge bases (Pisano 2006b). Three areas of concern must be addressed by the biotechnology industry in order to be successful: risk management and reward for risk-taking, integration of skills and capabilities for a range of disciplines and functions, and advancement of critical knowledge in the organisational structure, business models, industry levels and financing arrangements (Pisano 2006a).

There is a strong demand for a new approach to the study of entrepreneurship in the biotechnology industry. It is appropriate that a new research direction for entrepreneurship research should be based on an integrative approach (Morris et al. 2001). There is no research studying the relationship of the modes of opportunity exploitation (stand-alone venture or existing organisation) in the entrepreneurial process, the entrepreneurial type—personal achiever (PA), super sales people (SS), expert idea generator (EI) and real manager (RM) —market orientation, business climate, environmental uncertainty, competitive advantage and organisational strategy in the presence of entrepreneurial leadership capacity (ELC) as the mediating role in maintaining that relationship. Because of the importance it is given in entrepreneurship research, the role of ELC of the individual entrepreneur can enhance the entrepreneurial process for high-technology ventures (Street, Street & Lamont 2010). In addition, the values and strategies of entrepreneurial leadership can provide distinguishing competitive advantages for entrepreneurial organisations from others in the achievement of excellence in the dynamic business environment (Gaddefors 2007).

Purpose of this thesis

The purpose of this thesis is to propose a new model of entrepreneurship with entrepreneurial leadership capacity (EELC) for high-technology ventures in enhancing the pursuit of modes of exploitation in entrepreneurial process with good business models and enterprise performance. With the contribution of the literature in this new framework of entrepreneurial leadership capacity (ELC), this model will attempt to provide new insights to link some of the loosely-aligned pieces of knowledge, frameworks or theories present in this "multidisciplinary jigsaw" of entrepreneurship. Not many researchers have conducted research into entrepreneurship research by focusing on leadership principally. This proposed framework of ELC is a new concept which is applied in the disciplines of entrepreneurship and leadership. It is hoped that the outcome of this proposed model (EELC) will further contribute to the knowledge and theory building of entrepreneurship. This model of entrepreneurship for high-technology ventures will also offer an alternative direction for entrepreneurship research. The disciplines of entrepreneurship and leadership and the study of biotechnology industry will at least benefit from this EELC model with a better understanding of the interrelationships necessary for successful high-technology ventures.

This chapter proceeds in the following manner. First, the four related theories/frameworks and research questions related to the new model are discussed. Second, a brief methodology is introduced that describes the research method in collecting data for the verification of the new model. Third, an outline of the thesis is listed. Then it follows with the delimitations of scope and key assumptions. Finally, the chapter closes with summary comments.

1.3 Related Theories/Frameworks and Research Questions

The following section presents the four related theories/frameworks that are being used to research the proposed model of entrepreneurship: environmental dynamism theory; entrepreneurial type theory; leadership capacity and entrepreneurial leadership frameworks; and entrepreneurial process model. Based on the gaps on the research topic in the literature, the research questions that will be answered in this thesis are presented in the final section.

1.3.1 Related Theories/Frameworks

Four related theories/frameworks being used to research the proposed model of entrepreneurship are discussed: environmental dynamism theory; entrepreneurial type theory; leadership capacity and entrepreneurial leadership frameworks; and entrepreneurial process model.

1.3.1.1 Environmental Dynamism Theory

Environmental dynamism represents the perceived frequency of change and turnover in the marketing forces of the external/task environment (Aldrich, 1979).

Environmental dynamism, which represents the extent to which the external environment is erratic rather than stable, affects the utility of the various approaches or orientations in operating the organisations (de Hoogh, Hartog, Koopman, Thierry, van den Berg, van der Weide & Wilderom 2004).

Environmental dynamism includes examples such as business level strategy (e.g. Miller 1988), strategy-making processes (Rajagopalan, Rasheed & Datta 1993; Priem, Rasheed & Kotulic 1995), organisational structure (e.g. Burns & Stalker 1961), changes in technology, customer preferences, competitive action (Child 1972), creativity and innovation (Baron & Tang 2011; Jansen, Vera & Crossan 2009; Li & Simerly 2002), leadership (Jansen, Vera & Crossan 2009; de Hoogh, Hartog, Koopman, Thierry, van den Berg, van der Weide & Wilderom 2004) and environmental uncertainty (Scott 1992).

As environmental dynamism increases, those involved will experience an increased inability to assess accurately both the present and future state of the environment. Creating and sustaining a competitive advantage is a fundamental issue to the firms (Rumelt, Schendel & Teece 1991). In the real world, business firms face rapidly-changing environments, whereby the product research and development is increasingly accelerated, the life cycle of technology is continually shortened, and the frequent appearance of competing technologies happens (Jiao, Alon & Cui 2011). Top managers must develop creative and innovative strategies to deal effectively with these major challenges (D'Aveni 1994; Thompson 1967). In addition, firms should invest in firm-specific assets that help build temporary competitive advantages (D'Aveni 1994). The appropriate strategies include the investment of firm-specific assets to build temporary competitive advantage and the elimination of static competitive advantages of other firms (D'Aveni 1994; Grimm & Smith 1997).

In a dynamic environment, strong business leadership is essential, and in particular charismatic leadership (de Hoogh, Hartog, Koopman, Thierry, van den Berg, van der Weide & Wilderom 2004). It showed that employees are more likely to adopt positive attitudes towards work when their leaders are charismatic. This relationship, however, was especially pronounced when the environment was uncertain or dynamic.

1.3.1.2 Entrepreneurial Type Theory

Typologies are commonly used in the study of entrepreneurship and have an important role in the development of the discipline (Gartner 1985). Entrepreneurial typologies recognise the diversity that exists among entrepreneurs and permit grouping them according to their common characteristics, which may be critical to advancing our understanding of the reasons why different entrepreneurs found new ventures.

Besides, there is also a need for the change of research focus on the relationship between the entrepreneurs' personality traits and both business creation and business success instead of just focussing on the economics, finance and resource aspects of the venture (Rauch & Frese 2007).

Several researchers have developed typologies to classify entrepreneurs. Entrepreneurial typology or type is memorable, neat and evocative. Such typologies or types can be useful, in general, for studying complex issues because they allow researchers to categorise individual subjects (e.g. items, people, or organisations) into discrete groups, which, in turn, permits detailed analysis and intergroup comparison (Rich 1992).

Miner's entrepreneurial type (personal achiever (PA), super sales people (SS), expert idea generator (EI) and real manager (RM)) with the presence of individual distinct personality, will have the tendency or direction to pursue the appropriate entrepreneurial success route for ventures (Miner 2000; Muller & Gappisch 2005). The routes to entrepreneurial success (*achieving route, idea generating route*, *selling route and managing route*) provide the alternative journeys that the entrepreneurs can choose for entrepreneurial start-up ventures (Miner 1997). Real manager (RM) entrepreneurs will pursue the '*managing route*' of entrepreneurial success while the super sales people (SS) entrepreneur s will choose the '*selling route*'. Personal achiever (PA) and expert idea generator (EI) entrepreneurs will respectively choose the '*achieving route*' and '*idea generating route*' for entrepreneurial success routes. Each entrepreneurial type (PA, SS, EI and RM) should be able to utilise the characteristics of an entrepreneurial success route in the environment of entrepreneurial start-up.

1.3.1.3 Leadership Capacity and Entrepreneurial Leadership Frameworks

Leadership plays a crucial role in impacting organisational change and to leading innovation and organisational culture (Kotter & Heskett 1992; Bass 1998; Schein, 1992 and Brown, 1992). Besides, in the development and maintenance of values and excellence, leaders are being recognised as having the pivotal roles in organisations (Peters & Waterman 1982).

Leadership forms a central part of organisational capacity because leaders, in addition to representing the firm in the business arena, are responsible for setting organisational values and direction, and for inspiring employees to accept and work towards the mission and goals of the firm (Hinings & Greenwood 1989). Leadership capacity is concerned with a leader's experience, credibility, willingness to assume responsibility, ability to tolerate stress, and assertiveness (Street et al. 2011). Leaders should be more than just administrators or decision-makers. They can build and change an organisation (Barney & Arikan, 2001; Selznick, 1984). This leadership capacity is required to influence the organisation in such a manner that it is accepting of the first move, and thereby incorporates it in such a manner as to create performance-enhancing resources (Street et al. 2011). The leadership capacity of a leader indicates the strategic influence that leader can have on the firm (Leavy 1996). A firm's employees can be motivated by the influential leader to accept something new, like a first move. The success rate of building performance-enhancing resources in the first move can be facilitated through the acceptance of employees. The capacity of a leader (Leavy 1996) to have strategic influence when a firm is making a first move may affect that move's impact on performance. Leadership capacity can have the implications of improving creativity and innovation (Antes & Schuelke 2011; DiLiello & Houghton 2006).

Entrepreneurs as leaders must lead in setting up the standard operating procedures or organisational structures when a company is created from scratch. In the context of entrepreneurship, this “leadership” can be described as ”entrepreneurial leadership” which Kuratko and Hornsby (1998) suggest may be the emerging critical factor for the 21st-century corporation. The emerging importance of entrepreneurial leadership is due to the infusion of a corporate entrepreneurship mind-set in large corporations and the growing number of new start-up companies set up by young and talented entrepreneurs with innovative products. With entrepreneurial leadership built into the corporate strategies, the venture obtains competitive advantages by redefining the market continuously, restructuring operation, modifying business models and acquiring entrepreneurial skills (Kuratko & Hodgetts 2007).

Weiss and Molinaro (2005, p. 5) defines leadership capacity as “the extent to which organisations can optimise their current and future leadership to drive business results and successfully meet the challenges and opportunities of an ever-changing business environment.” On the other hand, the adopted definition of entrepreneurial leadership is “the entrepreneur’s ability to anticipate, envision, maintain flexibility, think strategically, and work with others to initiate changes that will create a viable future for the organisation” (Hitt, Ireland & Hoskisson 2001).

The combination of leadership capacity and entrepreneurial leadership is called “entrepreneurial leadership capacity” (ELC). By combining the definitions of leadership capacity and entrepreneurial leadership, the author has come up with this definition of ELC:

> “the extent to which, in an ever-changing business environment, the entrepreneurs/organisations can optimise their current and future leadership ability for anticipation, envision, flexibility, creative and strategic thinking, research and development for appropriate innovative inventions, recognition of innovation barriers, knowledge management, entrepreneurial activities for venture creation and initiation for collaborative change with sustainable business results and successful attainment of challenges and opportunities for a viable future for the organisation.”

ELC is a new term in entrepreneurship research. Measuring instruments for determining entrepreneurial leadership capacity have not been developed previously. It is the main objectives in this study to determine the components present in ELC and the significance of its role in the proposed model of entrepreneurship (EELC).

1.3.1.4 Entrepreneurial Process Model

A shift from the traditional focus on the characteristics and functions of the entrepreneur to a focus on the nature and characteristics of the entrepreneurial process is needed. In the process perspective, some common themes have emerged around the concept of *opportunity* as a central element in the process (Eckhardt & Shane 2003; Shane & Venkataraman 2000; Hills, Lumpkin & Singh 1997; Venkataraman 1997; Kirzner 1979).

Opportunities are recognised by entrepreneurs in various ways that are not yet well understood and are acted on, or exploited, by the entrepreneur or by others to whom the opportunity is sold or transferred. Based on prior work, entrepreneurial opportunities can be conceptualised as a subset of *all* possible opportunities.

Entrepreneurial opportunities require the creation or identification of new means–ends frameworks or relationships (Kirzner 1997).

Shane (2003) claims to provide the first exhaustive account of the theory of entrepreneurship in the last twenty years by offering an overarching conceptual framework that explains the different parts of the entrepreneurial process in a coherent way. His approach is a significant contribution to a theoretical understanding of the phenomenon of primary entrepreneurship as it is directed towards the relationship between the individual and the opportunity that ensures survival, growth and profitability to build on the experience gained in an initial public offering (IPO). The "individual-opportunity" nexus proposed as the basis of Shane's (2003) general theory of entrepreneurship is based on the definition of entrepreneurship provided by Shane and Venkataraman (2000) as an activity that involves the discovery, evaluation and exploitation of opportunities to introduce new goods and services, ways of organising, markets, processes and raw materials through organising efforts that previously had not existed.

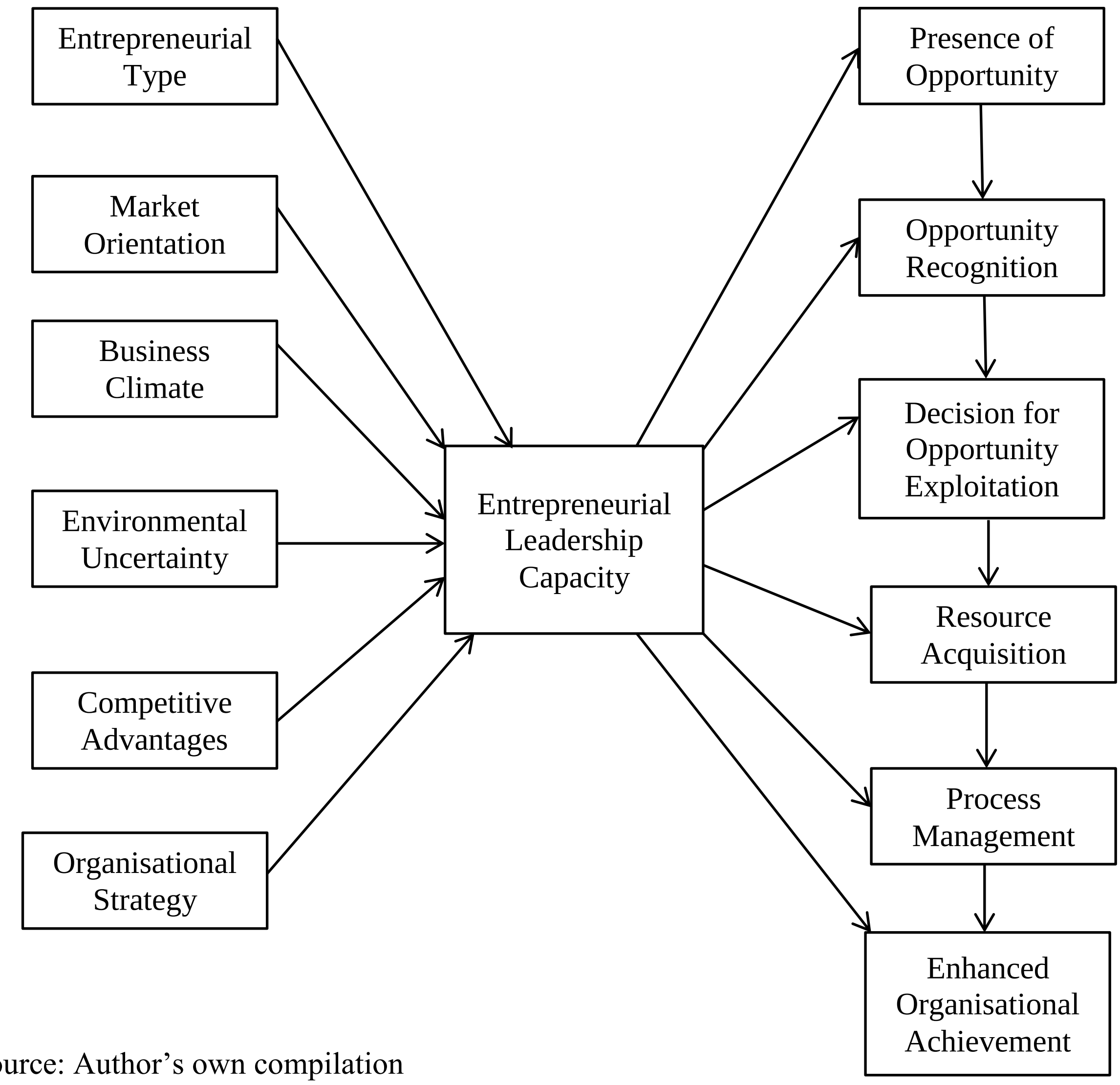
1.3.2 Research Questions

Based on the above, the four related theories/frameworks (environmental dynamism theory; entrepreneurial type theory; leadership capacity and entrepreneurial leadership frameworks and entrepreneurial process model) and the gap in the literature, this research for the proposed EELC model is justified. These four theories/frameworks provide the foundations for developing the research model and the hypotheses in the current study. Figure 1.1 shows the EELC model for high-technology ventures. Detailed discussion of the construction of the hypotheses can be referred to the sections of the model development in Chapter 3. With respect to the theoretical and practical significance of this study, high-technology entrepreneurs will benefit from the results of this study, helping the entrepreneurs to acquire the ELC to assure success in various modes of opportunity exploitation.

Gray (2009, p. 581) defines a research question as "a specific formulation of the issues that a research project will address, often describing general relationships between and among variables that are to be tested." In this thesis, the major research question is as follows:

> ***What are the factors/drivers and outcomes of a new model of entrepreneurship with entrepreneurial leadership capacity (EELC) for high-technology ventures?***

Figure 1.1 A new model of entrepreneurship with entrepreneurial leadership capacity (EELC) for high-technology ventures



Source: Author's own compilation

The findings of the thesis may show that there are strong relationships among the entrepreneurial type (PA, SS, EI and RM), the external drivers (market orientation, business climate, environmental uncertainty and competitive advantages), the internal driver (organisational strategy), the entrepreneurial leadership capacity (types of innovation and recognition of innovation barriers from financial, regulatory and resource perspectives) and the entrepreneurial process (presence of opportunity, opportunity recognition, decision for opportunity exploitation, resource acquisition, process management) in the new model of entrepreneurship for high-technology ventures.

The major research question is devolving into the following four specific research questions in this thesis.

1. ***How do the external drivers (i.e. market orientation, business climate, environmental uncertainty, competitive advantages) affect the entrepreneurial leadership capacity (ELC)?***

2. ***How do the entrepreneurial type and internal driver (i.e. organisational strategy) affect the entrepreneurial leadership capacity (ELC)?***

3. ***How does the entrepreneurial leadership capacity (ELC) affect the process steps in entrepreneurial process to obtain the enhanced organisational achievement?***

4. ***How can each process step in the entrepreneurial process model influence the enhanced organisational achievement?***

1.4 Research Methodology

Management research, which is considered to be a complex and ever-changing field, displays various interrelated patterns for special study (Gill & Johnson 2010). This makes it important that the research design follows the principles closely. DeForge (2010, p. 1252) describes research design as "the plan that provides the logical structure that guides the investigator to address research problems and answer research questions".

Various tools, models, frameworks and theories have been used to study the discipline of entrepreneurship, in particular of the characteristics of entrepreneurs. In the literature, there have been numerous studies on environmental dynamism theory *(*Miller 1988; Priem, Rasheed & Kotulic 1995; Jansen, Vera & Crossan 2009*)*, entrepreneurial type in the four-way psychological typology (FWPT) (Miner 2000), leadership capacity (Street et al. 2010; 2011), entrepreneurial leadership (Gupta et al. 2004), entrepreneurial opportunity exploitation (Shane 2003), business models (Morris, Schindehutte & Allen 2005), and enterprise performance (Covin & Slevin 1991) but they are all treated as separate fields for research. However, there still seems to be very little understanding of the significant role of entrepreneurial leadership in entrepreneurship, in particular of the new framework of entrepreneurial leadership capacity (ELC).

Scholars of entrepreneurship have advocated new research directions for entrepreneurship with cross-disciplinary, multilevel and holistic criteria approaches (Shane & Venkataraman 2000; Morris et al. 2001; Davidsson 2005; Low 2001). Research has been lacking in the understanding of the relationship of all these combined components in the study of entrepreneurship. This thesis is approaching the study of entrepreneurship with a new research direction by proposing a new model incorporating the ELC possessed by entrepreneurs in enhancing the pursuit of modes of exploitation with good business models and enterprise performance.

The latest direction for entrepreneurship research also promotes qualitative and mixed methods (Gartner & Birley 2002; Davidsson & Wiklund 2001). Apart from qualitative and quantitative methods, mixed methods research has attracted attention as a third major research approach (Gray 2009). Creswell (2009) defines mixed methods as “the collection or analysis of both quantitative and qualitative data in a single study in which the data are collected concurrently or sequentially, are given a priority, and involve the integration of data at one or more stages in the process of research”. There are three ways in which mixing can occur: the bringing together of two databases by merging or converging, the building of one database with the other one by connecting two databases, or the embedding of one database within the other supportive database (Creswell & Plano Clark 2007).

This new multidimensional integrative model has been developed from contemplation of the existing extensive literature which has led to the identification of a number of gaps in the explanatory power of extant models. After the new model was built and justified, it was applied to a study with a high-technology science-based industry (biotechnology) to simply validate its research findings. In the study, it was based on quantitative methods (Gray 2009; Kraska 2010).

Data obtained using a structured survey questionnaire with the sample size of 39 entrepreneurs from biotechnology companies can provide quantitative data required to test the validity of this new model shown in Figure 1.1. Although the sample size was not very big, this was good response rate (33.2%) from the population of 121 due to a large number of very small biotechnology companies. From experience, many small biotechnology companies only have one or two staff including the entrepreneur. It was extremely hard to get the permission to survey these entrepreneurs due to the immaturity or the early stage of industry life cycle for this particular industry. More details of the discussion can be found in Chapter 5.

In this research of the EELC model, the independent variables are entrepreneurial type (PA, EI, SS and RM), market orientation, business climate, environmental uncertainty, competitive advantages, and organisational strategy, while the dependent variables are presence of opportunity, opportunity recognition, decision for opportunity exploitation, resource acquisition, process management, business models and enterprise performance. An independent variable will act on a dependent variable only indirectly via the ELC variable, which is the mediator.

In the development of this model, a set of hypotheses is structured to test its validity for high-technology ventures. Quantitative data could be generated which were required for the development of this EELC model. Descriptive statistics are used to summarise the data in the analysis. Inferential statistics are applied to draw inferences from the sample chosen to the larger population that the sample is drawn from (Gray 2009).

Chapter 5 provides a very detailed discussion on the methodology including sampling plan, data collection methods and data analysis.

1.5 Outline of the Thesis

The dissertation proceeds in the following manner.

Chapter 1 provides the major elements of the thesis such as the background to the research, related theories/frameworks, research questions, a brief methodology, delimitations of scope and key assumptions. Finally, Chapter 1 closes with summary comments.

Chapter 2 summarises the literature review of related theories/frameworks (environmental dynamism theory, entrepreneurial type theory, leadership capacity and entrepreneurial leadership frameworks and the entrepreneurship theories). The characteristics of biotechnology and the industry overview of the Australian biotechnology market are also summarised in the last section.

Chapter 3 focuses on the discussion of the proposed new model of entrepreneurship with entrepreneurial leadership capacity (ELLC) for high-technology ventures. Seventeen hypotheses are constructed to test the validity of the new model of entrepreneurship.

Chapter 4 outlines the methodology of research design which includes data collection with the designed survey questionnaire and data analysis. Development of a measurement model is also discussed. Lastly, validity and reliability of research design are also discussed. An overview of the statistical analysis (Partial Least Squares Path Modeling (PLS-PM) for Structural Equation Modeling (SEM)) is summarised here as well.

Chapter 5 shows the data analysis, result and discussion sections of the survey data for the new model of entrepreneurship (EELC).

Chapter 6 lists the limitations of research and future research directions.

1.6 Delimitations of Scope and Key Assumptions

According to entrepreneurial type in the four-way psychological typology (FWPT), there are four entrepreneurial types: personal achiever (PA) entrepreneur, super sales people (SS) entrepreneur, expert idea generator (EI) entrepreneur and real manager (RM) entrepreneur. Due to the complexity and difficulty in handling the experimental nature of this study, no combination of two (or more than two) entrepreneurial types present in an entrepreneur is considered in this thesis. The primary objective of this study is to build up this EELC model.

Further tests or modification of the model can be applied to suit the real situation of samples having combinations of entrepreneurial types.

The entrepreneur sample present in five states (New South Wales, Victoria, Queensland, Western Australia and South Australia) of the Australian biotechnology firms was assumed to be homogenous and random. Some entrepreneurs were selected due to their availability during the survey time period.

1.7 Chapter Summary

The first section of this chapter highlighted the background to the research. Second, the four research questions related to the new model were discussed in detail. Third, a brief methodology was introduced which describes the research method of collecting data for the verification of the new model. The new multidimensional integrative model has been developed from contemplation of the existing extensive literature which has led to the identification of a number of gaps in the explanatory power of extant models. After the new model was built and justified, it was applied to a study with high-technology industry (the biotechnology industry), to simply validate its preliminary findings. In the study was based on quantitative methods (Gray 2009; Kraska 2010).

In this research of the EELC model, the independent variables are those identified above (PA, EI, SS and RM)

In this thesis, the major research question is as follows:

What are the factors/drivers and outcomes of a new model of entrepreneurship with entrepreneurial leadership capacity (EELC) for high-technology ventures?

The four research questions are:

1. How do the external drivers (market orientation, business climate, environmental uncertainty, competitive advantages) affect the entrepreneurial leadership capacity (ELC)?

2. How do the entrepreneurial type and internal driver (organisational strategy) affect the entrepreneurial leadership capacity (ELC)?

3. How does the entrepreneurial leadership capacity (ELC) affect the process steps in entrepreneurial process to obtain the enhanced organisational achievement?

4. How can each process step in the entrepreneurial process model influence the enhanced organisational achievement?

CHAPTER 2 LITERATURE REVIEW

2.1 Chapter Introduction

While Chapter 1 provides an introduction to the research problem and an overview of the thesis, Chapter 2 extends the introduction by building a theoretical foundation for the new model of entrepreneurship being developed in the thesis. This will be accomplished through a review of the extant literature on environmental dynamism framework, entrepreneurial type framework, entrepreneurial process model, leadership capacity framework, entrepreneurial leadership framework and overview of the Australian biotechnology industry.

2.2 Overview of Environmental Dynamism Framework

Among the organisation theory and strategic management literatures, environmental dynamism (ED) is considered as one of the widely-explored constructs (Miles, Covin & Heeley 2000). Generally, environmental dynamism refers to the rate and instability of changes in an organisation's external environment (Aldrich 1979; Dess & Beard 1984). It manifests in the degree of instability or turbulence of key operating concerns such as market and industry conditions, or more general economic, social, technological and political forces (Emery & Trist 1965; Dess & Beard 1984). Alternatively, environmental dynamism can refer to unpredictable rate of change in environmental conditions faced by firms (Dess & Beard 1984). Thus, dynamism deals with the notion of instability (volatility). Highly dynamic environments are those in which there is rapid and discontinuous change in demand, competitors, technology, and/or regulations such that information is often inaccurate, unavailable, or obsolete (Bourgeois & Eisenhardt 1988).

Environmental dynamism is the product of several forces operating at one time. These include an increase in the number and the size of organisations within an industry, and an increase in the rate of technological change and its diffusion throughout that industry (Simerly & Li 2000). Environmental dynamism includes the examples such as business level strategy (Miller 1988), strategy making processes (Rajagopalan, Rasheed & Datta 1993; Priem, Rasheed & Kotulic 1995), organisational structure (Burns & Stalker 1961), changes in technology, customer preferences, competitive action (Child 1972), creativity and innovation (Baron & Tang 2011; Jansen, Vera & Crossan 2009; Li & Simerly 2002), leadership (Jansen, Vera & Crossan 2009; de Hoogh, Hartog, Koopman, Thierry, van den Berg, van der Weide & Wilderom 2004) and environmental uncertainty (Scott 1992).

In studying the environmental characteristics, there are significant differences in terms of the impacts of environmental dynamism to firms across various industries (Moss 2010). As the levels of environmental dynamism have increased, it will reduce access to knowledge needed to make critical decisions. This, in turn, reduces the stability and predictability of relations among firms and their constituents within an industry. Since the degree of environmental dynamism varies across industries, it is acceptable to expect the significant differences in the adaptive capabilities required for sustainable survival, and that these differences should have performance implications (Simerly & Li 2000). Besides, in the absence of environmental demand for change, organisational performance is being focused as a reflection of how closely the firms can take the best advantage of their existing knowledge assets, business strategies, capabilities, routines and innovation in winning the competition (Wang & Li 2008).

Finally, Table 2.1 lists the summary of the related articles of environmental dynamism found in the literature.

Table 2.1 Related articles of environmental dynamism (ED) found in literature

Author	Type of article	Management			Issues					
		Organisational structure/ Strategy	Organisational performance/ Ownership	Finance	Individual/ Entrepreneur/ Entrepreneurship	Leadership	Moderator role	Creativity/ Innovation	Cognitive nature	General knowledge
Wang & Li (2008)	Empirical study		Performance				ED			
Simerly & Li (2000)	Empirical study		Performance	Capital structure						
Baron & Tang (2011)	Empirical study				Entrepreneur			Creativity/ Innovation		
Miles, Covin & Heeley (2000)	Empirical study	Structure & Strategy	Performance							
Li & Simerly (1998)	Empirical study		Ownership				ED			
Jansen, Vera & Crossan (2009)	Empirical study					Strategic leadership	ED	Innovation		
Akgün, Keskin & Byrne (2008)	Empirical study		Performance				ED		Emotional capability	
Jiao, Alon & Cui (2011)	Empirical study				Dynamic capabilities			Innovation		China
McArthur & Nystrom (1991)	Empirical study						Strategy-performance			Complexity and munificence
Hough & White (2003)	Empirical study								Strategic decision making	
Kim & Rhee (2009)	Empirical study	Exploration & exploitation								Internal variety

Table 2.1 Related articles of environmental dynamism found in literature (continued)

Author	Type of article	Management Issues								
		Organisational structure/Strategy	Organisational performance/ Ownership	Finance	Individual/ Entrepreneur/ Entrepreneurship	Leadership	Moderator role	Creativity/ Innovation	Cognitive nature	General knowledge
Hough & White (2004)	Empirical study								Strategic decision making	
Li & Simerly (2002)	Empirical study			Capital structure				Innovation		
Sohi (1996)	Empirical study		Performance		Salespeople's role perception					Job satisfaction
Gilley, McGee & Rasheed (2004)	Empirical study	Manufacturing outsourcing					Firm maturity			Managerial risk aversion
Priem, Rasheed & Kotulic (1995)	Empirical study		Performance						Strategic decision making	
Zhang (2007)	Empirical study		Performance		Top manager's dynamic capabilities					Information system support
Zhang (2006)	Empirical study	Strategic flexibility	Performance							Information system support
Lepak, Takeuchi & Snell (2003)	Empirical study	Employment flexibility	Performance							Technological intensity
Joshi & Campbell (2003)	Empirical study	Manufacture-supplier relationship								Contingency framework
Ketkar & Sett (2010)	Empirical study	Human resource flexibility	Performance							Multi-level causal model

Table 2.1 Related articles of environmental dynamism found in literature (continued)

Author	Type of article	Management Issues								
		Organisational structure/ Strategy	Organisational performance/ Ownership	Finance	Individual/ Entrepreneur/ Entrepreneurship	Leadership	Moderator role	Creativity/ Innovation	Cognitive nature	General knowledge
Wang & Chen (2010)	Empirical study	Technological diversity						Firm-specific innovation		Value appropriate-ion
Mascarenhas (1984)	Empirical study									Flexibility between ED and complexity
Wallace, Little, Hill & Ridge (2010)	Empirical study		Small firm performance		CEO regulatory foci					
Hassel & Cunningham (1996)	Empirical study	Multinational corporation		Budget effect-iveness						
Street, Marble III, & Street (2011)	Empirical study	Organisational capacity								First moves
de Hoogh, Hartog, Koopman, Thierry, van den Berg, van der Weide & Wilderom (2004)	Empirical study		Performance			Charismatic leadership				
Joshi & Campbell (2003)	Empirical study	Manufacturer-supplier relationship								Contingency framework
Garg, Walters & Priem (2003)	Empirical study		Manufacturing firm performance		Chief executive scanning emphases					
Romme, Zollo & Berends (2010)	Empirical study				Dynamic capabilities					Deliberate learning

2.3 Overview of Entrepreneurial Type Framework

This section first covers the discussion of entrepreneurial typology or type. Then Miner's (1996, 1997 & 2000) four-way psychological typology will be discussed. Lastly, another entrepreneurial typology such as the Big Five model of personality traits will also be introduced.

2.3.1 Entrepreneur Typology/Type

With the importance of entrepreneurship gaining more attention in the community and among the stakeholders, there have been a lot of studies done on this discipline, in particular of the research on recognition of entrepreneurial opportunities and exploitation of opportunities (Shane & Venkatraman 2000). It is very interesting to observe that some individuals are more or less likely to recognise entrepreneurial opportunities or to exploit them. Attempts to answer these two questions with the following studies are: personality (e.g. need for achievement and risk-taking propensity etc.), behavioural (e.g. management style) and demographic (e.g. industry experience), and, more recently, cognitive (e.g. entrepreneurial alertness) characteristics differentiating entrepreneurs from non-entrepreneurs (e.g. Hornaday & Aboud 1971; Busenitz & Barney 1997; Dunkelberg & Cooper 1982) and different types of entrepreneurs from each other (Smith 1967; Miner 2000; Gaglio & Katz 2001; Erikson 2001).

Despite the over-supply of theoretical work and a relative absence of empirical work in the literature (Gregoire, Noel, Dery & Bechard 2004), a demand for reducing common method variance, improving analysis, and conducting longitudinal research to capture the entrepreneurship process over time has been signalled by a recent review of the methodologies used in entrepreneurship research (Chandler & Lyon 2001). Besides, there is also a need for the change of research focus on the relationship between the entrepreneurs' personality traits and both business creation and business success instead of just focussing on the economics, finance and resource aspects of the venture (Rauch & Frese 2007).

Currently, most extant typologies or types classify entrepreneurs based on either demographic or personality characteristics. Given that cognitive studies focus on how entrepreneurs acquire, process, store, and use information (Baron 2004). developing a cognitive-based typology appears to be an important next step. Research suggests that entrepreneurs, especially successful ones, may possess a schema that assists them in recognising opportunities (Ardichvili, Cardozo & Ray 2003). Several typologies or types have grouped entrepreneurs on the basis of their psychological characteristics, with most typologies focusing on the personality characteristics of entrepreneurs (e.g. Miner 1996, 1997, 2000; Muller & Gappisch 2005). Some typologies have examined the psychological characteristics of subpopulations of entrepreneurs and have formed typologies of potential entrepreneurs (Erikson 2001), female entrepreneurs (Langan-Fox & Roth 1995), nascent entrepreneurs (Korunka, Frank, Lueger, & Mugler, 2003), retiree entrepreneurs (Singh & DeNoble 2003), and fatherless entrepreneurs (Strenger & Burak 2005).

Several studies tried to compare different entrepreneurial types by consolidating the information in the literature as shown in Tables 2.2 and 2.3 (Tang, Tang & Lohrke 2008; Hisrich, Langan-Fox & Grant 2007). Table 2.2 summarises a shorter version of selected classification of entrepreneurial types from previous entrepreneurship research (Tang, Tang & Lohrke 2008), while Table 2.3 is a more comprehensive collection of various entrepreneurial types. (Hisrich, Langan-Fox & Grant 2007).

There are so many permutations of entrepreneurs that some sort of grouping is necessary if only for the benefit of parsimony. Typologies of entrepreneurs are beneficial for theory development because theories require the summarisation of variable content in order to arrive at a set of variables that make a meaningful whole. Clustering recognisable types will enable researchers to identify types and replicate research findings, as well as aid analysis (e.g. discriminant analyses of variables associated with different types). Types also have practical value inasmuch as one can ascertain which types might prove to be more or less successful entrepreneurs, and this has implications for selection and training.

Table 2.2 A comparison of selected entrepreneurial typologies

Author	Key classification dimensions	Entrepreneurial type
Smith (1967)	Background Education Work experience Social/business behaviour	1. Craftsmen 2. Opportunists 3 organisation types
Filley and Aldag (1978)	Business strategies Management styles	1. Craft 2. Promotion 3.Administrative
Smith and Miner (1983)	Education and training Social involvement Management styles Communication ability Sources of capital	Further establish the craftsmen- opportunistic dimension in research on entrepreneurship 1. Craftsmen 2. Opportunists
Miner (2000)	Various psychological personality factors	1. Personal achiever 2. Real manager 3. Expert idea generator 4. Empathic super-salesperson
Erikson (2001)	Desirability Feasibility Proactivity	1. The ready entrepreneur 2. The ready reluctant 3. The ready feasible 4. The ready unconvinced
Gaglio and Katz (2001)	Different locations on the continuum of entrepreneurial alertness	1. Assessing 2. Discounting 3. Dismissing 4. Uninterested
Ucbasaran *et al.* (2004)	Process knowledge Domain knowledge Information search/motivation	1. Naïve novice 2. Transient over-achiever novice 3. Long-term novice 4. Transient novice 5. Biased habitual 6. Transient habitual 7. Routine habitual 8. Expert habitual

Source: Adapted from Tang, Tang & Lohrke (2008)

Table 2.3 Summary for Entrepreneurial Typologies

Author(s)	Name of entrepreneur type	Description of type
Cooper, Ramachandran, & Schoorman (1997)	Craftsman	Emphasizes noneconomic goals (e.g., doing the work he or she wants to do and avoiding working for other people); is less likely to have had previous, high-level management experience; devotes less time to administrative activity and more time to "doing" activity (e.g., sales, production).
	Administrative (more successful)	Emphasizes economic goals (e.g., is less likely to see the business as a vehicle for a certain lifestyle); is more likely to have had previous, high-level management experience; delegates "doing" activity and allocates time to administrative activity.
Erikson (2001) Typology of potential entrepreneurs	Ready	Proactive; sees entrepreneurship as desirable and feasible; self-governed; continuously recognizes new opportunities; allocates resource base to meet situational demand.
	Ready reluctant	Not proactive, sees entrepreneurship as desirable and feasible; might not act on opportunities unless encouraged.
	Ready unfeasible	Proactive; sees entrepreneurship as desirable but unfeasible.
	Ready unconvinced	Proactive; sees entrepreneurship as undesirable but feasible.
	Daydreamer	Not proactive, sees entrepreneurship as desirable but unfeasible.
	Undesirable	Not proactive; sees entrepreneurship as undesirable but feasible.
	Uncredible	Sees entrepreneurship as neither desirable or credible.
	Bureaucrat	Will probably never become an entrepreneur.
Korunka, Frank, Lueger, & Mugler (2003) Typology of nascent entrepreneurs	Nascent entrepreneurs against-their-will	Low need for achievement; low internal locus of control; low personal initiative; strong push factor; little social support; underestimation of organizational effort; low use of information.
	Would-be nascent entrepreneurs	Strong self-realization motive; strong perception of positive role models; enhanced internal locus of control; enhanced security motive; unfavorable financial situation.
	Networking nascent entrepreneurs with risk-avoidance patterns	Low risk-taking propensity; perceived supportive environment; intense use of information; low organizational effort; careful appraisal of risk.
Lafuente & Salas (1989) Typology of entrepreneurs based on work expectations	Craftsmanship	Primarily guided by expectations of work itself; secondary expectations focus on performance and organizational context; uncertainty and challenge are not potential sources of satisfaction.
	Security	Expectations are centered on impact of work on family welfare; expectations related to challenge and uncertainty also play a role.
	Risk/challenge	Likes risk and challenge; expectations for improving family welfare are unimportant.
	Managerial	Managerial expectations; secondary expectations related to improving family welfare.
Langan-Fox & Roth (1995) Typology of female entrepreneurs	Need achiever	Highest on need for Achievement (*n*Ach); lowest on activism (planning for a career), job satisfaction, self-attributed need for Achievement (*san*Ach), ability to influence/have power, need for influence, and self-attributed need for Power (*san*Pow)
	Pragmatic	Moderate *n*Ach, *san*Ach, ability to influence/have power, activism, job satisfaction, and trust; lowest on independence from family, internal locus of control, and resistance to subordination; motivated by opportunity to pass on business to children and earning more money in self-employment.
	Managerial	Lowest on *n*Ach; high ability to influence/have power; *san*Pow and Influence, and resistance to subordination; highest on activism, internal locus of control, job satisfaction, *san*Ach; low trust.

Table 2.3 Summary for Entrepreneurial Typologies (continued)

Author(s)	Name of entrepreneur type	Description of type
Miner (1997, 2000)	Personal achiever	Need to achieve; desire to plan and set goals; desire for feedback; strong personal initiative; strong personal commitment to firm; belief that one person can make a difference; internal locus of control; belief that work should be guided by personal goals, not by others.
	Empathic super salesperson	Capacity to understand and empathize; desire to help others; belief that social processes are important; belief that a sales force is crucial to company strategy; desire to have strong positive relationships with others.
	Real manager	Desire for corporate leader role; decisiveness; positive attitude to others; desire to compete; desire to stand out from crowd; desire for power.
	Expert idea generator	Desire to innovate; love of ideas; belief that new product development is crucial to company strategy; intelligence; desire to avoid risk taking.
Miner, Smith, & Bracker (1992)	Craftsman	(See Smith, 1967, below)
	Opportunistic	(See Smith, 1967, below)
	Inventor	Craftsman orientation; high priority placed on new product development strategies and patent production; uses his or her firm as a vehicle for invention and producing the product invented rather than for growth.
Muller & Gappisch (2005)	Creative acquisitor	Idea generator or intuitive type; tolerance of ambiguity, intuitive problem-solving orientation and salesperson type; interpersonal reactivity.
	Controlled perseverator	Stress resistance, emotional stability; level of arousal; analytical problem-solving orientation.
	Distant achiever	Need for achievement and autonomy.
	Rational manager	Assertiveness, analytical problem-solving orientation, risk-taking propensity.
	Egocentric agitator	Maladapted type, level of arousal; low interpersonal reactivity, internal locus of control.
Singh & DeNoble (2003) Typology of retiree entrepreneurs	Constrained	High entrepreneurial attitude, self-efficacy, and entrepreneurial and innovative orientation.
	Rational	Medium on entrepreneurial attitude, self-efficacy, and innovation.
	Reluctant	Low on entrepreneurial attitude, self-efficacy, and innovation.
Smith (1967); Smith & Miner (1983)	Craftsman	Narrowness in education and training (technical only); low social awareness and involvement; a feeling of incompetence in dealing with the social environment; limited time orientation.
	Opportunistic	Breadth in education and training; high social awareness and involvement; confidence in dealing with the social environment; awareness of and orientation to the future.
Strenger & Burak (2005) Typology of fatherless (male) entrepreneurs	Entrepreneurs who become their own fathers (successful)	Emotionally come to terms with their fathers' failure; use entrepreneurship as a way to repair the emotional damage of having been let down.
	Self-destroyers (unsuccessful)	Deep-seated rage and unconscious guilt; overtly cocky and rebellious but do not feel they truly deserve success; destroy their own achievement.
	Grandiose dreamers (unsuccessful)	Desperate need for their fathers' affection and love; feel an inner void; fantasize about becoming successful; driven by an image of being praised and recognized; strive for ever-grander achievement; lose ability to differentiate between actual personal capacity and fantasized grandeur; ignore warning signs leading to downfall.

Note. All typologies are empirically based with the exception of Singh and Denoble's (2003), which is theoretically grounded.

Source: Hisrich, Langan-Fox & Grant (2007)

Among the economic, social-environment and psychological approaches, the personality trait theory of psychological approach has been widely researched to investigate the likelihood of an individual becoming an entrepreneur (Gartner 1989). Psychological assessment is often employed by venture capital firms as a screen test to find out the personality, or "character" of the founders-to-be of a company who are seeking venture capital investment. Although there is much debate on the validity and accuracy of these psychological assessment tests, this kind of personality test is still seen as a good tool and sound investment by the founders in the decision for going ahead with their investment.

The following section will discuss Miner's four-way psychological typology in more detail (1996, 1997 & 2000).

2.3.2 A Four-Way Psychological Typology

Miner's early research of psychological typology was on managerial motivation (1971, 1976 & 1977). The studies described a principle of managerial role motivation to depict the type of motivational traits required for success in most management positions in large, hierarchical organisations. A test called the "Miner sentence completion scale" was used to measure managerial motivation. An overall score as well as separate scores are provided by the test on each of the six aspects of managerial motivation.

Many research projects on the relationship between managerial motivation and advancement have been summarised by Miner's study. In large organisations, significant correlations were discovered between a manager's overall score on managerial motivation and advancement to higher levels of management. The special motivation subscales that correlated most consistently with advancement included: desire to use power, desire to compete with peers, and a positive attitude toward authority figures.

Results from early research on leaders in smaller organisations indicated that managerial motivation was not useful for predicting advancement. However, a later study found positive results even for small organisations (Berman & Miner 1985). Generally speaking, in Miner's research, managerial motivation predicted advancement in large organisations but the results were inconsistent for small organisations. Based on these studies, Miner (1996, 1997 & 2000) continued to research on the psychological typology of successful entrepreneurs with the introduction of a four-way psychological typology (FWPT).

Miner (2000) argues that typologies are more than just taxonomical classification systems providing decision rules for categorising phenomena (data) into groups of exclusive sets. The nature of typologies is conceptual and *a priori*, which gives important outcomes for organisations. In his four-way psychological typology study, Miner (2000) has combined both typology types and personality instead of investigating each factor individually. Miner’s (2000) four-way psychological typology (FWPT) is different from previous typologies and previous entrepreneurial personality theories which only studied the aspect of personality related to the achievement motivation. Tables 2.4 and 2.5 list the characteristics of individual psychological profile for entrepreneurs such as “personal achiever” (PA), “super sales people” (SS), “expert idea generator” (EI) and “real manager” (RM). These four psychological profiles are interpreted as the four “routes” that entrepreneurs might follow in search of success as entrepreneurs (Miner 1996).

Table 2.4 Characteristics of personal achievers and super sales people in the four-way psychological typology

Entrepreneurial types	Characteristic	Description
Personal achievers (PA)	*Motivation for self-achievement	This factor was the very first characteristic being studied. Degree of achievement satisfaction can vary between individuals. Achieving for success is the major concern rather than avoiding failure. They prefer situations in which they can influence and have clear-cut individual responsibility.
	*Type A personality-achieve more in less time	The person can achieve more in less time. Not all type As are the same in the personality.
	*Desire for feedback on achievement	Certain kinds of people have the desire to be acknowledged about their level of performance which can be recognised as motivational effects
	*Desire to plan and set goals for future achievements	They tend to think and plan about the future with the personal goals for achievement.
	*Strong personal commitment to their ventures	They have a value-based identification with their ventures, e.g. a strong belief in and acceptance of the organisation's goals and values, a willingness to exert considerable effort on behalf of the organisation, and a strong desire to maintain membership in the organisation
	*Desire to obtain information and learn	They are very practical, hard-working and pragmatic to get any and all information to make the successful and efficient business.
	*Internal locus of control	It refers to the people's perception of the extent to which control over events resides within themselves internally. This makes planning possible and contributes to the formulation of effective strategies.
	High value placed on careers in which personal goals and work demand govern	These are people who believe a really good job is one where they set their own goals, strive to accomplish those goals as they see fit, and live or die by the extent to which they correctly figure out what the task requires.
	Low value placed on careers in which peer groups govern	They believe in personal causation and personal responsibility. One can clearly identify who did the work and who should get the credit in an ideal work situation.
	Strong personal initiative	They are self-starters who do not need assistance from others to accomplish their tasks.
Super sales people (SS)	*Capacity to understand and empathise others	They acquire information by sensing, listening, and interacting with people and they evaluate information by using their feelings and instincts. They have little tolerance for ambiguity. They have a talent for building teams and encourage participation at work.
	*Belief in the importance of social processes	They emphasis the social interaction and relationships with other people. This can facilitate the sales process. This characteristic reflects the person's work values such as the importance of making a contribution to society, having pleasant and agreeable co-workers, being valued as a person, having the esteem of others, having the opportunity of meeting people and receiving recognition from others for doing a good job.
	*Desire to help others	They have the idea of enjoying being of service to and helping others. The desire to help others may come from a strong concern for others, a warm and understanding need to be of service and a sense of internal satisfaction by providing help instead of receiving it. Consumers are motivated to return the favour by buying the product.
	*Good at external relationship building	They need good relations to feel at ease and secure. Their self-esteem can be dependent on how other regard them and relate to them. They encourage others in participating in the decision-making process and welcome new ideas or different approach to a problem.
	*Belief in sales forces	They recognise a sale force to be an important means of implementing company strategies. Sales force is to be considered a very important role among the other functions such as advertising, delivery, discounts, new product development, package, price, quality, reciprocity, reputation, services and variety.

Note: * Characteristics studied in the research by Miner (2000)

Source: Miner (1997)

Table 2.5 Characteristics of the expert idea generator and real manager in the four-way psychological typology

Entrepreneurial types	Characteristic	Description
Expert idea generator (EI)	*Desire to innovate personally	They enjoy coming up with new ideas and implementing them. Original or novel or creative or innovative approaches are the distinct features.
	Build venture around new products	Mostly they are involved in developing new products and services. They consider that new product development is important to the company's strategic positioning. This characteristic is critical to the success of inventor-entrepreneurs and their firms.
	*Involved with high-tech companies (conceptual in cognitive style)	They love creative ideas and enjoy solving problems. They can tolerate high ambiguity and risk taking. They are insightful, adaptive, flexible and enthusiastic. They have strong desire for showing concerns for others, intuition, a need for independence and pursuit for personal goals. They prefer loose, decentralised organisational structures. They play an important role in determining how entrepreneurs approach their firms.
	*Intelligence as source of competitive advantage	This characteristic is a crucial role for the expert idea generator. Intelligence is considered to involve such capabilities as judgment and reasoning, and the capacity to deal with ideas, abstractions, and concepts, the ability to learn, insightfulness, and the capacity to analyse and to synthesise.
	*Desire to avoid taking risks	This type of entrepreneur may be much more risk avoiders. Their enthusiasm for ideas and innovation may direct them into actions that may threaten the venture. Avoiding risk is the counterforce to restrain this enthusiasm.
Real manager (RM)	*Positive attitudes towards authority	Good and effective managers will possess positive attitudes towards authority. They should not provoke negative reactions from their superiors. They should be in a position to represent their units upward in the organisation and to obtain support for their actions at higher levels.
	*Desire to compete with others	For successful managers, they must compete for scarce rewards both for themselves and their groups. Those who enjoy doing so are likely to perform better in the pyramidal nature of hierarchic organisations.
	*Desire to assert oneself	Assertiveness appears to be part of managerial talent. Management prefers to have this type of person to be in charge, make decision, take disciplinary actions and make protection for others. They are proactive rather than reactive
	*Desire to exercise power and to be corporate leader	Managers need to exercise their power over subordinates and guide their behaviour in a manner consistent with organisational goals. Proper exercise of power and positive attitude to it can contribute to successful performance as a manager.
	*Directive in cognitive style	They focus on tasks, technical problems, giving particular attention to facts, rules and procedures. This kind of manager is impersonal and capable of using power to be forceful. They can fit well with structured, goal-oriented organisations where power and authority are used to get things done as quickly as possible.
	*Desire to stand out from the crowd	Persons who can stand out from the group and assume the position of high visibility can meet the role requirement as managers and proved to be effective in their work.
	*Desire to perform managerial tasks	These managers have the desire to perform the various routine activities in a responsible manner associated with managerial work. A good manager has the desire to do what the job requires.
	High supervisory ability	They have the capability to direct the work of others, and to organise and integrate their activities to meet the goals of organisation.
	Strong self-assurance	This characteristic provides the foundation and support which can enable the person to cope with problems during confrontation. Faith in oneself is essential if a person has to act effectively.
	Strong need for occupational advancement	Some individuals are eager to achieve appointments to high-level positions. Such people with a strong desire for occupational advancement should be motivated to perform better at higher managerial levels in the organisation
	Strong need for self-actualisation	Some people will try their best to seek opportunity to utilise their talents to the fullest extent but not leaving their capabilities to be unfulfilled. Self-actualisation is critical for high-level managerial work. Managerial effectiveness becomes their goal to achieve self-actualisation.
	Weak need for job security	Those best performance managers will not have a sense of job insecurity because they have a weak need for job security. Otherwise they will be attracted to the management role.
	Strong personal decisiveness	Good managers must exhibit the strong personal decisiveness based on very limited information. Otherwise serious consequences may include the disruption of corporate operations.

Note: * Characteristics studied in the research by Miner (2000)

Source: Miner (1997)

Garman and Phillips (2006) describe Miner's four-way psychological typology as the most received empirical support for predictive entrepreneurial success.

The first of Miner's entrepreneurial types is the "personal achiever" (PA), whose characteristics include the motivation for self-achievement, the desire for feedback and the desire to plan and set goals for future achievements; all of which were aspects of McClelland's theory of achievement motivation (McClelland 1961a). Miner also includes strong personal initiative, high value placed on careers where personal goals, individual accomplishments and the demands of the work govern, as well as strong personal commitment to their ventures and desire to obtain information and learn. Johnson (1990) suggests that the desire for achievement may be the dominant psychology-based predictor for venture success. Garman and Phillips (2006) note that the PA entrepreneur is quite hard to work with when the investors want to have a high degree of control over their investments. They recommend that the PA entrepreneur is more suited to situations in which their track record and/or expertise warrants substantial trust on the part of their financial backers (Miner 2000).

The "real manager" (RM) type according to Miner, "derives from theory and research indicating that at some point on the entrepreneurial firm growth curve managers must assume authority and introduce systematisation" (Miner 2000, p. 47). The characteristics identified here are positive attitudes towards authority; desire to compete with others; desire to assert oneself; desire to exercise power; directive in cognitive style; desire to stand out from the crowd and desire to perform managerial tasks. A real manager entrepreneur has the desire to compete, be assertive and stand out for their success with a positive attitude towards authority and frequent use of power. Since RM does not have the same strong need for personal achievement as the other types do, they can more readily build collaborative teams. There are not many RMs in entrepreneurial ventures because they are more comfortable working as managers in large organisations. An RM may find the start-up phase of a new venture too challenging to cope with and not enjoyable and is much more likely to feature in the later stage of an entrepreneurial venture (Miner 2000).

The "expert idea generators" (EI), who Miner says may also be the inventors, have the desire to personally innovate; are conceptual in cognitive style; have high intelligence and desire to avoid taking risks. They are problem-solvers. The EI entrepreneur will focus more on finding the solution than how the solution can help the customer. EIs are characterised by the desire to innovate and be creative, the intention to avoid risk taking and a high level of intelligence. Since EIs tend to focus on ideas and concepts, they may bring in those new products and services to the market according to their interest rather than in response to market needs. The other danger that EIs may run into is the crippling of their capability to function during the start-up phase of venture creation because of their unwillingness in take risks in uncertain situation (Miner 2000).

The "empathetic super sales person" (SS) is empathic in cognitive style and desires to help others. There is a high value attached to social processes and to harmonious social relationships, and they are anxious to help people with their problems. SS entrepreneurs are considered as very customer-oriented, willing to help others and sociable. SS is eager to understand client needs and always find ways to meet these needs. However, if SS goes beyond the organisation's resource limitation and external competition, the venture will be in jeopardy even if the SS is otherwise successful (Miner 2000).

2.3.3 The Big Five Model of Personality Traits

Much research has focused on identifying the types of entrepreneurial personality and their importance to the success of ventures (Littunen 2000). The Big Five model of personality traits (BFMPT) has been shown to be a robust indicator of an individual's personality. It classifies personality into the categories of extraversion, emotional stability or neuroticism, agreeableness, conscientiousness and openness to experience (Digman 1990). Although its validity as a tool for determining entrepreneur's personality has been verified by extensive empirical research, this descriptive model of personality is not a theory (Goldberg 1993). Because of its usefulness as an indicator, BFMPT is being used here to investigate the relationship between the entrepreneur's personality and the overall long-term survivability of the venture (Ciavarella, Buchholtz, Riordan, Gatewood & Garnett 2004).

It is proposed in this new model to link Miner's four-way psychological typology and the Big Five model of personality trait by using a mapping technique as the new research direction for entrepreneurship which will be explained more in detail in Chapter 6. This new linkage approach can further develop the four-way psychological typology based on the widely accepted five-factors model of personality.

The Big Five factors (extraversion, emotion stability or neuroticism, agreeableness, conscientiousness, and openness to experience), one of the most widely accepted comprehensive models of personality, has been used to investigate the relationship between the entrepreneur's personality and the overall long-term survivability of a venture. From the findings of the study by Ciavarella et al. (2004), extraversion, emotional stability and agreeableness did not show relationships to long-term venture survival. Once an individual high in conscientiousness and/or low in openness to experience decides to become an entrepreneur, this person can commit to bring the venture from the start-up phase to venture survivability and then into venture maturity and a longer venture life span. However, they also discovered "a negative relationship between openness and the entrepreneur's ability to lead the new venture to long-term survival." Another study which has similar results to Ciavarella et al. (2004), demonstrated the relationship between Big Five personality and entrepreneurial status (Zhao & Seibert 2006). Results indicate that there were significant differences on personality dimensions between entrepreneurs and managers such as higher scores on conscientiousness and openness to experience, and lower scores on neuroticism or emotion stability and agreeableness. No difference was found for extraversion.

The Big Five model of personality traits has become one of the most widely accepted comprehensive models of personality (Barrick & Mount 1991). The Big Five factors, traits and their descriptive components are listed in Table 2.6 (Ciavarella et al. 2004). Goldberg (1993) suggests that there are two five-factors models, one developed by McCrae and Costa (1985) and operationalised in the NEO Personality Inventory (NEO-PI); the other version associated with studies based on the lexical hypothesis and operationalised in the sets of factor markers issued by Norman (1963), and Digman and his associates (Digman & Inouye 1986). Both versions are essentially the same model. Goldberg (1993, p. 30) provides the following explanation:

(a) The number of dimensions is identical, namely five; (b) the content of Factor IV is essentially the same, although it is oriented in the opposite direction in the two models and is thus so labelled (Emotional Stability versus Neuroticism); and (c) there is considerable similarity, although not identity, in the content of Factor III (Conscientiousness). On the other hand, at least two of the differences between the models are quite striking: (a) The locations of Factors I and II are systematically rotated so that warmth is a facet of Extraversion in the lexical model; and (b) Factor V is conceived as Openness to Experience in the NEO-PI and as Intellect or Imagination in the lexical model.

Major, Turner and Fletcher (2006, p. 928) describes the Big Five factors as the following:

The Big Five factors include Neuroticism (i.e. tendency to experience negative factors affects, such as fear, sadness, embarrassment, anger, guilt, and disgust), Extraversion (i.e. tendency to like people, prefer being in large groups, and desire excitement and stimulation; likelihood to be assertive, active, talkative), Openness (i.e. tendency to have an active imagination, esthetical sensitivity, intellectual curiosity, and be attentive to feelings), Agreeableness (i.e. tendency to be altruistic, cooperative, and trusting), and Conscientiousness (i.e. tendency to be purposeful, organised, reliable, determined, and ambitious). Each of the five factors is composed of several components.

Table 2.6 The Big Five factors, traits and components

Big Five factors	Traits	Components
Extraversion (surgency)	Sociable, gregarious, assertive, talkative, active	<u>Ambition</u>-initiative, surgency, impetuous, like to be in charge, seeks leadership roles, persuasive <u>Sociability</u>-talkative, gregarious, enjoys meeting people <u>Individuality</u>-shows off, enjoys taking chances and stirring up excitement
Stability/Emotional stability (neuroticism)	Calm, even-tempered, self-satisfied, comfortable, unemotional, hardy, stable, confident, effective	<u>Steady</u>-even-tempered, steady emotionally <u>Security</u>-feels secure about self, not bothered by criticism
Agreeableness (likability, friendliness)	Being courteous, flexible, trusting, good-natured, cooperative, forgiving, soft-hearted, tolerant	<u>Cooperative</u>-likes to help others and does things for friends, trusting of others <u>Considerate</u>-good-natured, cheerful, forgives others easily
Conscientiousness (conformity, dependability)	Responsible, well-organised, resourceful, hardworking, achievement-oriented, persevering	<u>Dependability</u>-thorough, careful <u>Industriousness</u>-strives to do best, does more than planned, hardworking, persistent <u>Efficiency</u>-neat and orderly, plans in advance, rarely late for appointments
Openness to experience (intellect)	Being imaginative, creative, cultured, curious, original, broadminded, intelligent, artistically sensitive	<u>Intellect</u>-imaginative, likes abstract ideas and concepts, analytical and introspective, enjoys philosophical debates <u>Open</u>-cultured, like to try new and different things, enjoys art, music, literature

Source : From Table 1 in Ciavarella et al. (2004)

2.4 Overview of Entrepreneurial Process Model

This section explains the concept and foundation of entrepreneurship with an overview of the definition of entrepreneurship, the major theories of entrepreneurship, the main approaches to entrepreneurship research and the entrepreneurial process model. The focus of discussion in this section is on the entrepreneurial process.

2.4.1 What is Entrepreneurship?

Since the study of entrepreneurship covers a broad range of fields it is an elusive concept with its own meaning in individual disciplines. It is very difficult to give a precise meaning to the term entrepreneurship, and consensus is very hard to obtain among scholars.

The problem with better understanding entrepreneurship starts at the first step—the definition of an entrepreneur (Gartner, Shaver, Gatewood & Katz 1994; Hornaday 1992). The researchers propose their own definition, and believe that they have taken into account most of the factors related to an "entrepreneur". For Adam Smith, the entrepreneur is a "capitalist"; for Richard Cantillon, a "decision maker"; for Jean-Baptiste Say, an "industrial leader" and a "manager"; for Arthur Cecil Pigou, an "owner of an enterprise"; and for Israel Kirzner, an "allocator of resources for alternative uses" (Herbert & Link 1988). In general, an entrepreneur is one "who specialises in taking responsibility for and making judgemental decisions that affect the location, the form, and the use of goods, resources, or institutions." This definition not only emphasises the activity side of the "entrepreneurship" (i.e. taking responsibility, making decisions etc.) but also relates it to the context and the content (Herbert & Link 1988).

Table 2.7 summarises the nature of entrepreneurship taken from seven of the most prevalent perspectives on the nature of entrepreneurship (Morris, Lewis & Sexton

1994). Of these seven, creation of enterprise, employment and growth are perhaps the most obvious and widely-used perspectives of entrepreneurship.

Table 2.7 Summary of seven perspectives on the nature of entrepreneurship

Perspective	Nature of Entrepreneurship
Creation of wealth	Entrepreneurship involves assuming the risks associated with the facilitation of production in exchange for profit.
Creation of enterprise	Entrepreneurship entails the founding of a new business venture where none existed before.
Creation of innovation	Entrepreneurship is concerned with the unique combination of resources that make existing methods or products obsolete.
Creation of change	Entrepreneurship involves creating change by adjusting, adapting, and modifying one's personal repertoire, approaches, and skills to meet different opportunities available in the environment.
Creation of employment	Entrepreneurship is concerned with employing, managing, and developing the factors of production, including the labour force.
Creation of value	Entrepreneurship is a process of creating value for customers by exploiting untapped opportunities.
Creation of growth	Entrepreneurship is defined as a strong and positive orientation towards growth in sales, income, assets, and employment.

Source: Morris, Lewis & Sexton (1994)

There is no agreed definition among academics and research scholars (Gartner 1990). After surveying 36 scholars and 8 business leaders with a set of 90 attributes, Gartner (1990) concluded that there was great focus on new venture creation, new business creation with added value, opportunity capitalisation, resource allocation for a perceived opportunity and innovation implementation.

Morris (1998) reviewed 75 entrepreneurship definitions found in management or entrepreneurship journal articles and leading textbooks published over a five-year period. His findings are summarised in Table 2.8. Fifteen key terms for entrepreneurship definition appeared at least five times in the reviewed literature sample. The most common key terms found in this study were consistent with

Gartner (1990) and included start-up or a new venture creation; innovation or creation of new combinations of resources; pursuit of opportunity; the marshalling of necessary resources; risk-taking; profit-seeking and value creation.

Table 2.8 Survey of key terms identified in content analysis of 75 contemporary definitions of entrepreneurship

[1]Key Term	No. of Mentions
1. Starting/founding/creating	41
2. New business/new venture	40
3. Innovation/new products/new market	39
4. Pursuit of opportunity	31
5. Risk-taking/risk management/uncertainty	25
6. Profit-seeking/personal benefit	25
7. New combinations of resources, means of production	22
8. Management	22
9. Marshalling resources	18
10. Value creation	13
11. Pursuit of growth	12
12. A process of activity	12
13. Existing enterprise	12
14. Initiative-taking/getting things done/proactiveness	12
15. Create change	9
16. Ownership	9
17. Responsibility/source of authority	8
18. Strategy formulation	6

[1] Key terms receiving five or more mentions
Source: Morris (1998)

Kao (1995, pp. 83-84) defines entrepreneurship a**s:**

> **“**the process of doing something new (creative) and something different (innovative) for the purpose of creating wealth for the individual and adding value to society.”

Besides this, the OECD generally describes entrepreneurship as “the ability to marshal resources to seize new business opportunities” (OECD 1998). This description by the OECD (1998) continues:

> “Entrepreneurship is central to the functioning of market economies. Entrepreneurs are agents of change and growth in a market economy and

> they can act to accelerate the generation, dissemination and application of innovative ideas."

Schaper, Volery, Weber and Lewis (2011, p. 5) define entrepreneurship as:

> "the process, brought about by individuals, of identifying new opportunities and converting them into marketable products or services."

In this study, the definition of entrepreneurship by Schaper, Volery, Weber and Lewis (2011, p. 5) is being adapted.

2.4.2 Approaches to Entrepreneurship

Within the advancement of the study of contemporary entrepreneurship, many concepts are interdisciplinary and these concepts may provide the foundation for a better understanding of entrepreneurship (Gartner 1990).

There is a need to categorise these diverse concepts in a systematic manner. Kuratko and Hodgetts (2007) have proposed the following two approaches to study entrepreneurship: the entrepreneurial schools of thought approach and the process approach (Table 2.9). These two approaches offer a good starting point for the study of entrepreneurship in a more systematic manner. In the entrepreneurial schools of thought approach, there are two streams - the macro and micro views of entrepreneurship. There are three streams in the entrepreneurial process approach - the event, assessment and multidimensional approaches. There is also a third approach, which is the integrative approach proposed by Morris et al. (2001). The discussion here is focussed on the entrepreneurial process approach in particular the multidimensional approach and the integrative approach.

Table 2.9 Two approaches to study entrepreneurship

Approach	Description		Reference
Entrepreneurial Schools of Thought Approach	Macro View	Environment School of Thought	Ven de Ven (1993)
		Financial/Capital School of Thought	Brophy and Shulman (1992)
		Displacement School of Thought	Ronstadt (1984)
	Micro View	Entrepreneurial Trait School of Thought (People School)	Shaver & Scott (1991); Kuratko (1989)
		Venture Opportunity School of Thought	
		Strategy Formulation School of Thought	Covin & Slevin (1990)
Entrepreneurial Process Approach	Entrepreneurial	Events Approach	Bygrave (1989)
	Entrepreneurial	Assessment Approach	Ronstadt (1984)
	Multidimensional	Approach	Johnson (1990) & Gartner (1985)

Source: Kuratko & Hodgetts (2007)

2.4.2.1 Entrepreneurial Schools of Thought Approach

The entrepreneurial school of thought proposes “macro” and “micro” views of the conceptual nature of entrepreneurship. The macro view of entrepreneurship covers a wide range of factors such as the external processes relating to the success or failure in entrepreneurial ventures. These external processes may be beyond the control of the individual entrepreneur. The macro view concentrates on events from the outside looking in. Three schools of entrepreneurial thought are the environmental; the financial/capital and the displacement schools of thought. The environmental school of thought is considered to be the broadest and the most pervasive one.

<u>Macro View</u>

(1) The environmental school of thought

This school of thought investigates the influence of external factors on the lifestyle of a potential entrepreneur which can be a positive or a negative force in shaping the entrepreneurial ambition. A socio-political environmental framework including institutions and value can strongly motivate the development of entrepreneurs (Van de Ven 1993). The social group environment can also encourage the potential development of entrepreneurs.

(2) The financial/capital school of thought

The capital-seeking process for seed capital and growth capital is the main emphasis in the financial/capital school of thought (Brophy & Shulman 1992). This approach uses the financial management perspective to review entrepreneurial ventures. Indeed, the venture capital process is crucial to developing the entrepreneurial venture throughout different stages of start-up or acquisition.

(3) The displacement school of thought

Ronstadt (1984) has postulated that individuals will not pursue a venture unless they are prevented or displaced in political, cultural or economic groups. These external forces in displacement can affect the development of entrepreneurship. Political displacement will occur when the political regime rejects free enterprise by government regulations. Social groups with ethnic background, religion, race and gender, may experience cultural displacement when they are precluded from professional fields. Economic variations such as recession, depression, job loss and capital shrinkage may lead the individual to pursue an entrepreneurial career.

The micro view of entrepreneurship explores the factors of the internal locus of control in which the outcome of each major influence can be directed or adjusted by the potential entrepreneur. The micro view approach emphasises the specifics from the inside looking out. The entrepreneurial trait school of thought is the most widely-recognised concept other than the venture opportunity and strategy formulation schools of thought.

Micro View

(1) The Entrepreneurial trait school of thought

The followers of this school of thought believe that the identified common traits or characteristics of successful people may be traced and copied by other entrepreneurs in leading to higher success opportunities (Shaver & Scott 1991). Common traits such as achievement, creativity, determination and technical knowledge are the most obvious four characteristics found in successful entrepreneurs. Moreover, there has been strong debate against the educational development component of entrepreneurs, suggesting that it results in the inhibition of the creative and challenging nature of entrepreneurship (Shaver 1975). Kuratko (1989) has proposed that new educational developments and programs can be implemented to assist entrepreneurial development. It is believed that some traits which are established and supported early in life will eventually lead to the success of the entrepreneur.

(2) The venture opportunity school of thought

Opportunity aspects such as the search for sources of ideas, the development of concepts and the implementation of venture opportunity, are the focal points for this school of thought about venture development. It is also believed that the key to entrepreneurial success is to develop the right idea at the right time for the right market niche. In addition, entrepreneurs should have the ability to recognise the venture opportunities when they arise and to implement the necessary steps for action (Kuratko & Hodgetts 2007).

(3) The Strategy formulation school of thought

Since strategic planning is part of the process of management, taking a strategy formulation approach in entrepreneurial theory with the emphasis on the planning process in successful venture development is logical (Covin & Slevin 1990).

Strategy formulation is recognised as a leveraging of unique elements, for example, unique markets, unique people, unique products or unique resources. These unique elements are analysed, utilised or incorporated into effective venture creation. This school requires an interdisciplinary approach with managerial capability.

Other than the above micro view approach to the entrepreneurial schools of thought, Cunningham and Lischeron (1991) have also proposed the following six schools of thought with different interests:

A. Assessing personal qualities

    1) The "Great Person" school of entrepreneurship

    2) The psychological characteristics school of entrepreneurship

B. Recognising opportunities

    3) The classical school of entrepreneurship

C. Acting and managing

    4) The management school of entrepreneurship

    5) The leadership school of entrepreneurship

D. Reassessing and adapting

    6) The intrapreneurship school of entrepreneurship

Table 2.10 (Cunningham & Lischeron 1991 p. 47) summarises the central focus, assumption, behaviours and skills, and situation for each of the six schools while Table 2.11 (Cunningham & Lischeron 1991 p. 56) lists the definitions and criteria for each entrepreneurial school. In Table 2.10, each entrepreneurial model can be applied to different situation of venture stage (e.g. start-up, early growth, maturity or change) with various central focus, assumption and behaviour skills. The psychological characteristics school and leadership school are also incorporated in the proposed new model of entrepreneurship in this dissertation, which will be discussed later in the literature review.

Table 2.10 Various models of one approach to the entrepreneurial schools

Entrepreneurial Model	Central Focus or Purpose	Assumption	Behaviors and Skills	Situation
"Great Person" School	The entrepreneur has an intuitive ability—a sixth sense—and traits and instincts he/she is born with.	Without this "inborn" intuition, the individual would be like the rest of us mortals who "lack what it takes."	Intuition, vigor, energy, persistence, and self-esteem.	Start-up
Psychological Characteristics School	Entrepreneurs have unique values, attitudes, and needs which drive them.	People behave in accordance with their values; behavior results from attempts to satisfy needs.	Personal values, risk taking, need for achievement, and others.	Start-up
Classical School	The central characteristic of entrepreneurial behavior is innovation.	The critical aspect of entre-preneurship is in the process of doing rather than owning.	Innovation, creativity, and discovery.	Start-up and early growth
Management School	Entrepreneurs are organizers of an economic venture; they are people who organize, own, manage, and assume the risk.	Entrepreneurs can be devel-oped or trained in the techni-cal functions of management.	Production planning, people organizing, capitalization, and budgeting.	Early growth and maturity
Leadership School	Entrepreneurs are leaders of people; they have the ability to adapt their style to the needs of people.	An entrepreneur cannot accomplish his/her goals alone, but depends on others.	Motivating, directing, and leading.	Early growth and maturity
Intrapreneurship School	Entrepreneurial skills can be useful in complex organi-zations; intrapreneurship is the development of inde-pendent units to create, market, and expand services.	Organizations need to adapt to survive; entrepreneurial activity leads to organizational building and entrepreneurs becoming managers.	Alertness to opportunities, maximizing decisions.	Maturity and change

Source : Cunningham & Lischeron (1991)

Table 2.11 Definitions and criteria of one approach to the entrepreneurial schools

Entrepreneurial Model	Definition	Measures	Questions
"Great Person"	"Extraordinary Achievers"	Personal principles Personal histories Experiences	What principles do you have? What are your achievements?
Psychological Characteristics	Founder Control over the means of production	Locus of control Tolerance of ambiguity Need for achievement	What are your values?
Classical	People who make innovations bearing risk and uncertainty "Creative destruction"	Decision making Abilities to see opportunities Creativity	What are the opportunities? What was your vision? How did you respond?
Management	Creating value through the recognition of business opportunity, the manage-ment of risk taking . . . through the communi-cative and management skills to mobilize . . .	Expertise Technical knowledge Technical plans	What are your plans? What are your capabilities? What are your credentials?
Leadership	"Social architect" Promotion and protection of values	Attitudes, style Management of people	How do you manage people?
Intrapreneurship	Those who pull together to promote innovation	Decision making	How do you change and adapt?

Source : Cunningham & Lischeron (1991)

2.4.2.2 Entrepreneurial Process Approach

Apart from the entrepreneurial schools of thought approach, the process approach is another alternative to studying entrepreneurship that has advanced the field. This approach describes the involved steps or stages and identifies the factors constraining and facilitating the entrepreneurial process. Generally, the process approach comprises the stages: opportunity identification to business concept definition, resource requirement analysis, resources acquisition, and harvest and management of the venture (Stevenson, Roberts & Grousbeck 1989). Despite the existence of various methods and models to describe the entrepreneurial process and its various factors, only three of the most common process approaches are discussed below: entrepreneurial event, entrepreneurial assessment and multidimensional approaches.

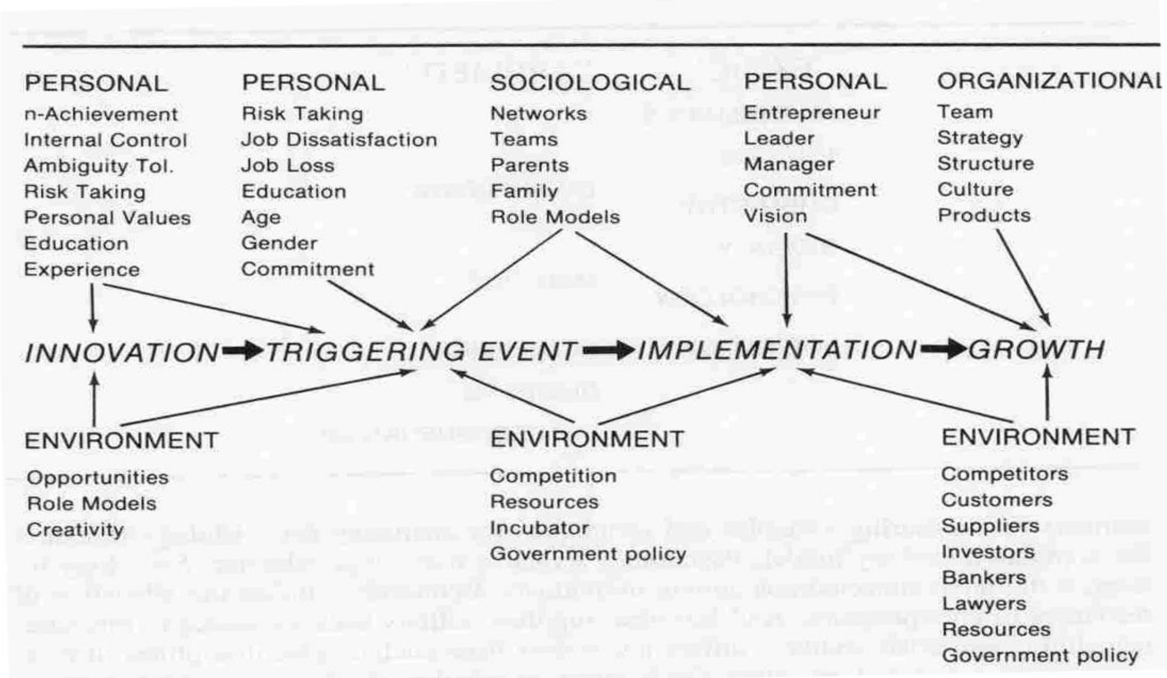
(1) Entrepreneurial events approach

The entrepreneurial event approach concentrates on the implementation and control of the process of entrepreneurial activities. There are several concepts affecting each event. Bygrave (1989) has proposed a model with theoretical concepts from basic social science and practical concepts from applied science as shown in Figure 2.1. Each event, such as innovation, triggering event, implementation and growth will affect each other in the process in the presence of other elements.

(2) Entrepreneurial assessment approach

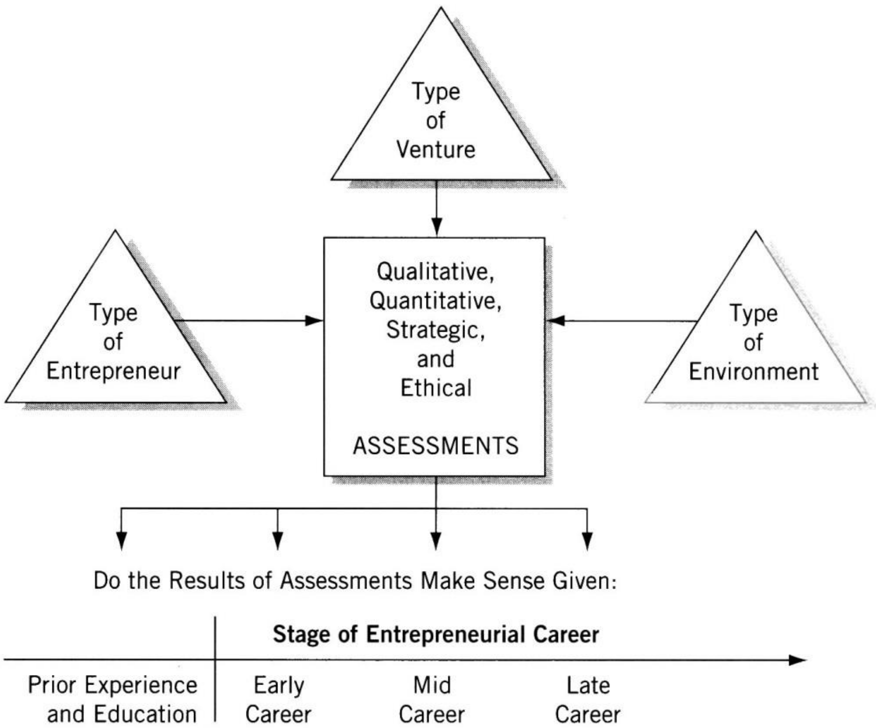
Ronstadt (1984) has developed the assessment approach with the process described as “the entrepreneurial perspective”. In Figure 2.2 the entrepreneur, the venture and the environment have to go through the assessment process qualitatively, quantitatively, strategically and ethically. Each of the assessment results has to compare with the three stages of entrepreneurial career: early, mid-career and late career.

Figure 2.1 Entrepreneurial event formation process approach



Source: Bygrave (1989)

Figure 2.2 Entrepreneurial assessment approach



Source: Ronstadt (1984)

Many researchers have viewed entrepreneurship as not a single event but rather a process which will unfold over time and advance through distinct and related phases (Stevenson & Jarillo 1990; Rosa 1998; Baron & Shane 2005; Gaddefors 2007).

Shane (2003) argues that:

> "The scholarly field of entrepreneurship would be much better off if academics devoted more energy toward the development of a comprehensive framework for entrepreneurship that incorporated the effects of individuals, as well as the effects of opportunities and the institutional and industry environment in which the pursuit of opportunity occurs, than on attempts to prove the superiority of one perspective over another."

In his book, Shane (2003) proposes the individual-opportunity nexus as a conceptual framework for the field of entrepreneurship which can provide empirical support for the various propositions emerging from it.

> "The entrepreneurial process begins with the perception of the existence of opportunities, or situations in which resources can be recombined at a potential profit. Alert individuals, called entrepreneurs, discover these opportunities, and develop ideas for how to pursue them, including the development of a product or service that will be provided to customers. These individuals then obtain resources, design organisations or other modes of opportunity exploitation, and develop a strategy to exploit the opportunity."

Shane and Venkataraman (2000) propose the individual-opportunity nexus as a conceptual framework for the field of entrepreneurship which can provide empirical support for the various propositions emerging from it. The individual-opportunity nexus framework of Shane and Venkataraman (2000) forms the structure for the entrepreneurial process in this proposed model of entrepreneurship for high-technology ventures.

(3) Multidimensional approach

Past research has led to findings that have been somewhat fragmented or unidimensional in addressing just a single aspect of new venture creation (Morris et al. 2001). By taking into account the evolving and complex nature of entrepreneurship involving multi-disciplines and multiple stakeholders, a multidimensional approach to studying entrepreneurship can offer a better choice to fully understand the inter-relationship between the phenomena (Gartner 1985; Johnson 1990; Kouriloff 2000; Yamada 2004).

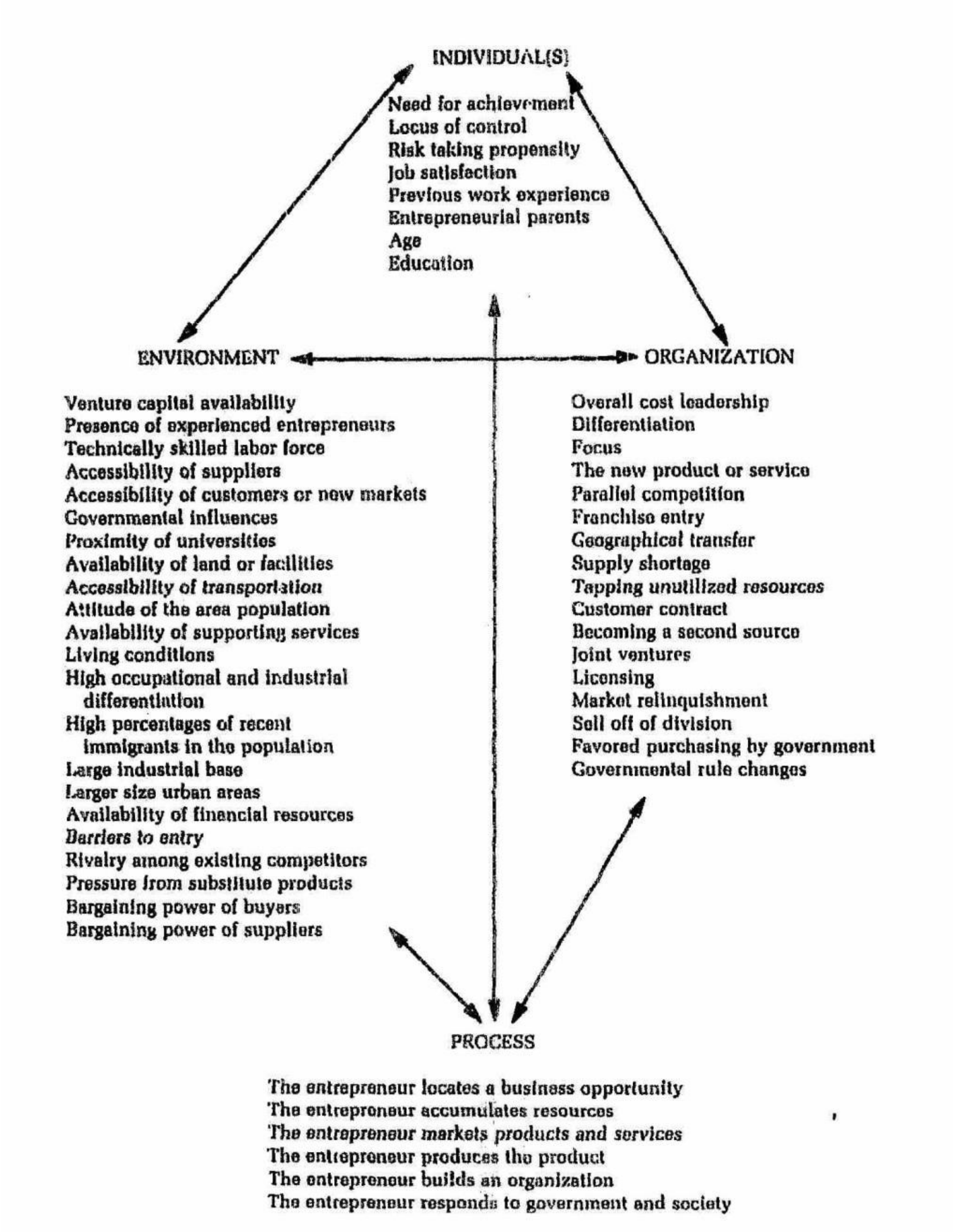
A multidimensional approach is considered as the more detailed process approach to the study of entrepreneurship (Johnson 1990). Gartner (1985) was one of the pioneers to propose a multidimensional approach to study new venture creation, in his case consisting of four dimensions: the individual, the organisation, the environment and the new venture process. In Gartner's conceptual framework (1985), he proposed as follows:

> "Listing each variable of new venture creation under the appropriate dimension of the framework illustrates the potential for a high degree of complexity in the interaction of these variables within the multidimensional phenomenon of venture creation. The four dimensional conceptual framework can be seen as a kaleidoscope, as an instrument through which to view the enormously varying patterns of new venture creation…One way in which the framework can be useful is in identifying those aspects of new venture creation neglected by a particular study. New research may then be designed to account for these lacunae… The

> framework outlines a format for future research methodologies and for reporting such research."

In this approach, entrepreneurship is being viewed as a complex, multi-dimensional framework comprising of the individual, the organisation, the venture process and the environment. In each dimension there are specific factors related to each other. Gartner (1985) has presented this approach with the new venture creation in Figure 2.3. With the multidimensional approach, it has shifted entrepreneurship from a segmented school of thought to a dynamic and interactive process approach.

Figure 2.3 Multidimensional approach for new venture creation

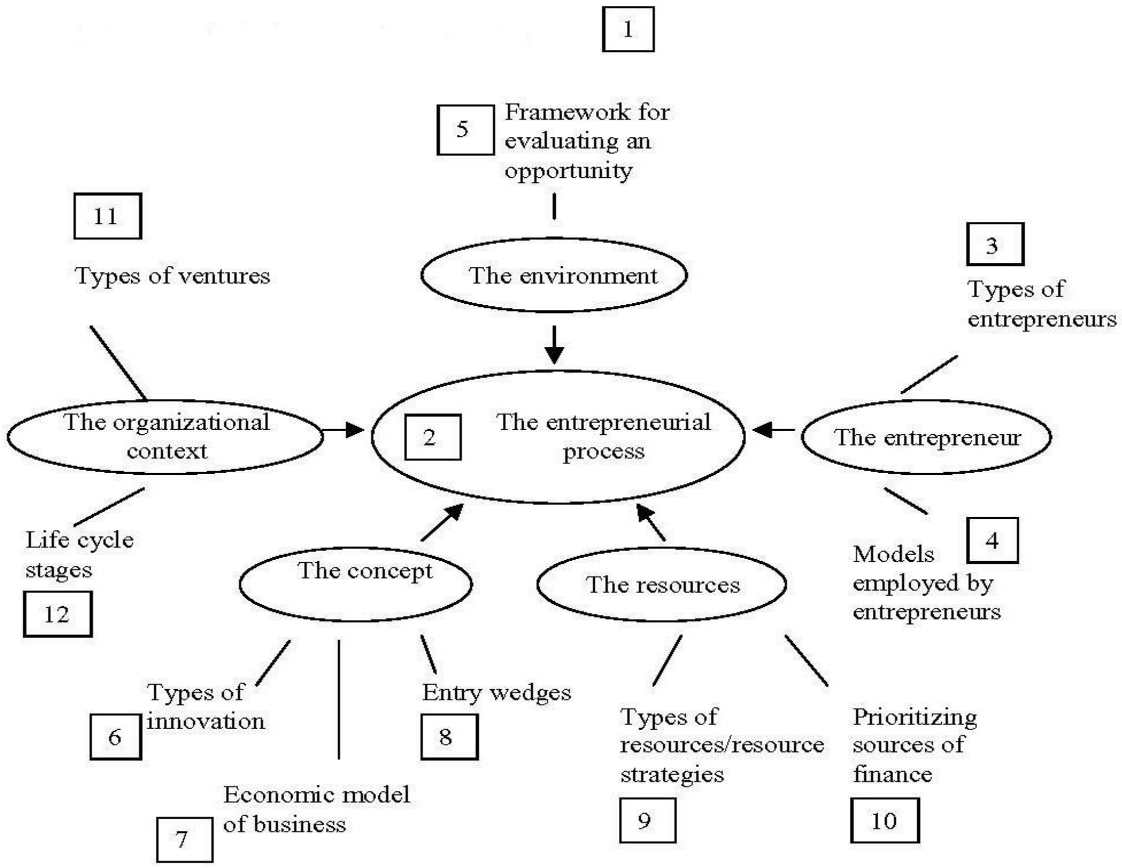


Source: Gartner (1985)

2.4.2.3 An Integrative Approach

Since the creation of a new venture is a multidimensional phenomenon, it is appropriate a new research direction for entrepreneurship research should be based on an integrative approach with various dimensions (Gartner 1985; Yamada 2004). Although frameworks for the entrepreneurial process have been proposed, there is not a complete and integrated framework. Knowing that there is a strong need for a thorough and integrated framework for entrepreneurship, Morris et al. (2001) have worked towards for the development of a proposed "framework of frameworks" shown in Figure 2.4. Their integrative frameworks have further developed Gartner's (1985) multidimensional approach to the study of entrepreneurship. The main objectives for this integrative framework for entrepreneurship are as follows:

Figure 2.4 An integrative framework for entrepreneurship



Source: Morris et al. (2001)

Their integrative frameworks have further developed Gartner's (1985) multidimensional approach to study of entrepreneurship. The main objectives for this integrative framework for entrepreneurship are as follows: (Morris et al. 2001):

> "We propose an integrative framework for understanding the phenomenon of entrepreneurship, and attempt to demonstrate how this comprehensive perspective incorporates a number of the other frameworks currently available in the field. We believe that this represents an important step towards the ultimate objective of establishing a comprehensive typology that is theoretically solid and that underpins further efforts to build theories and irrefutable laws of entrepreneurship. "

In the integrative frameworks by Morris et al. (2001), the proposed framework has been developed by building on existing knowledge in the field. It further develops a systematic overview of the critical elements that serve to explain and predict entrepreneurial activity. Despite a sizeable body of research being developed that supports individual elements of the framework as well as positive relationships across other elements, these integrative frameworks contribute to knowledge in the field of entrepreneurship. They enhance the understanding of the field by defining the domain of entrepreneurship and its constituting elements (Morris et al. 2001).

In Figure 2.4 (Morris et al. 2001), entrepreneurship is considered as the consequence of the interactions of a number of factors. It has been summarised as the integrative framework consisting of six key factors which also tie together ten other frameworks influencing the entrepreneurial process, as shown in Figure 2.4:

1) The process
2) The entrepreneur
3) The environment
4) The business concept
5) The resources
6) The organisational context.

As shown in Figure 2.4, numbers 2-12 have been put close to the six key variables. These numbers stand for additional frameworks that will be crucial for explaining each variable of the overall framework. This is why this integrative perspective can be recognised as a "framework of frameworks". A brief discussion of the six key factors follows (Morris et al. 2001):

1. <u>The entrepreneurial process</u>

Entrepreneurship can be conceptualised as a process which can be broken down into specific stages or steps with a logical progression. Any organisation can implement this entrepreneurial process from the start-up venture to the established corporation, to the public enterprise.

2. <u>Types of entrepreneurs</u>

Four types of entrepreneurs have been identified: personal achievers, expert idea generators, "super" sales people and real managers (Miner 2000). It is important to have a match between the type of entrepreneur and the type of venture he/she pursues.

3. <u>The environment</u>

It is the setting which provides the "rule of the game" for the entrepreneur to run the business within the constraint of entrepreneurial behaviour. It also gives the specific conditions for creating the opportunity for a specific entrepreneurial concept.

4. <u>The business concept</u>

The business concept is interpreted as the total value package of resources that comprises service or process, new product penetration or a company structure.

5. <u>The resources</u>

The resources that the entrepreneur can manage can affect the ability to match the business concept to an opportunity. The resources can be regarded as the finance, distribution channels, supply relationships, identification and acquisition of human resources, technologies and physical locations.

6. <u>The organisational context</u>

The entrepreneur needs to have certain kinds of organisational context to run the entrepreneurship. The context can be the franchise, the corporate research laboratory, home-based business, the new venture, the partnership operating out of an incubator and the individual licensing.

After very thorough literature review, the integrated framework for entrepreneurship by Morris et al. (2001) is the only one being proposed so far in entrepreneurship research that provides a good foundation and framework to further study entrepreneurship in this dissertation. The proposed new model of entrepreneurship in this dissertation, which further develops the frameworks of Morris et al. (2001) in the relationships of entrepreneurs, process and organisation with the additional mediator of entrepreneurial leadership, contributes to knowledge of building a comprehensive theory of entrepreneurship. Later, the new model is applied in the high-technology (like biotechnology) industry for testing its validity. Literature review on entrepreneurial leadership will be provided later.

2.4.3 Major Theories of Entrepreneurship

Entrepreneurship has taken a critical and significant role in the transformation of nations in terms of social stability through wealth and job creation, advancement of research and technology, and financial sustainability etc. In the entrepreneurship research, there has been a shift in research emphasis in the course theory/framework development. In recent times, the research focus has shifted away from a focus on the characteristics of people and firms who act in entrepreneurial ways to one that focuses on the processes of entrepreneurship itself – on opportunity recognition and exploitation. It has moved also from an economic rationalist approach, that assumes perfect information, rational expectations and optimisation as the determinants of entrepreneurship (Kihlstrom & Laffont 1979; McClelland 1961), to a disequilibrium and behavioural approach, which focuses on the understanding of opportunities discovery (Eckhardt & Shane 2003; Shane 2000) and acted upon by people and firms (Shane & Venkataraman 2000; Lumpkin & Dess 1996).

2.4.3 .1 Economics Perspective

A lot of academic thoughts on entrepreneurship can be traced back to early economic literature. Among the most influential researchers on economics theories of entrepreneurship are from the work of three contrasting thinkers: Israel Kirzner (alert discoverers of profit opportunities), Joseph Schumpeter (innovators and creative destructors) and Frank Knight (uncertainty-bearers). These economists have three different approaches to the economics view of entrepreneurship as:

1) A discovery process (Kirzner 1973; 1977)

2) An innovation process (Schumpeter 1934)

3) An uncertainty bearing process (Knight 1921).

Kirzner (1973; 1977) views entrepreneurship as the enabler and discoverer of the market process. It proposes that entrepreneurs utilise their early recognition of discontinuities in the path towards a subsequent equilibrium state and thereby manage higher levels of risk to capture the profit that comes from the early discovery, exploration and exploitation of opportunities that have not yet become conscious to others. It means that market equilibriums are reached from states of disequilibrium through the profit opportunities recognised by entrepreneurs. In this discovery process view, markets are characterised as being in a state of constant disequilibrium due to imperfect and limited information and resulting inefficiencies (Hayek 1945). Entrepreneurs pursue opportunities to make extra profit by exploiting market disequilibriums which will drive the economy towards equilibrium conditions till the absence of such opportunities. The exploitation of profit opportunities by entrepreneurs alerts others to the opportunities and draws in imitators until eventually competition reduces profit levels to normal levels and equilibrium is restored (Shane & Venkataraman 2000). The significant contributions of Kirzner have been the focus attention on the ”alertness” in entrepreneurial discovery and on the role of learning and knowledge development and diffusion in market processes.

Schumpeter (1934) views entrepreneurship (an innovation process) in a different but complementary way as a dis-equilibrating process, a way of driving market change and innovation, or what may be called disruptive entrepreneurship. Schumpeter's (1934) position suggests that entrepreneurs provide the break from equilibrium pathways towards creative destruction of prior equilibrium states by reducing their personal risk and lowering their own uncertainty, through novel and hence market space-creating activity. The greater ability to recognise opportunities was a function of a person's creativity (Schumpeter 1934). Five types of innovation were identified by Schumpeter (1934) as: (1) introduction of new products, (2) introduction of new methods of production, (3) opening of new markets, (4) introduction of new materials or sources of supply, and (5) developing new organisational structures. Innovators (entrepreneurs) enjoy "temporary monopoly power" (Baumol 1993, p. 6) and, when imitators see that above-normal gains can be made, they enter and erode the entrepreneur's profit and return the market to equilibrium. It also introduced a critical dimension of "social value" that addresses the issues of the relationship between the individual and society in managing wants, values and demand that contribute to social marginal utilities as an influence on achieving a social equilibrium outcome (Schumpeter 1961).

Unlike the Kirznerian and Schumpeterian view, the Knightian view treats entrepreneurship as an uncertainty-bearing process. Knight (1921) differentiated between the notion of risk, which is calculable, and uncertainty, which is not. The entrepreneurial task is rewarded with the residual income (profit), which is the reward for bearing uncertainty. The difference between risk and certainty is well described by using the metaphor of the urn containing different coloured balls (Sarasvathy 2001). Risk is akin to drawing a red ball from an urn containing five green balls and five red balls – whose probability can be precisely calculated because we know the underlying distribution of balls inside the urn. Uncertainty is similar to drawing a red ball, except we do not know how many balls are in the urn, what colours they are, or even if there are any red balls at all in the distribution. The former consists of known distribution and unknown draws, while the latter consists of non-existent distribution and unknowable probabilities, referred to as Knightian uncertainty (Knight 1921).

Alternatively, Knight's (1921; 1967) position on entrepreneurship involves the uncertainty-bearing process like the sales of output tomorrow using resources bought and recombined today, suggesting that people who discover opportunities might have greater perceptive ability about the future recombination of resources. This factor is called "foresight" (Shane 2003). In Knight's view, opportunity recognition is a function of a person's intelligence and foresight (Shane 2003). Knight (1921) argued that differences in intellectual capacity would influence people's likelihood of opportunity discovery.

In summary, the Kirznerian, Schumpeterian and Knightian views can be described as three aspects of the same market and entrepreneurial process.

2.4.3.2 Innovation Perspective

There is a growing interest in literature for the study of the nature and importance of innovation and entrepreneurship (Chandler, Keller & Lyon 2000). These studies link between the effectiveness of innovation management and sustainable competitive advantage. Lin (2001, p. 1) describes that "Success in the twenty-first century can only come from competing through continuous corporate innovation." This demonstrates the importance of innovation in the entrepreneurship.

The ground rules of Schumpeter's theory of innovation are found in his economic model of the circular flow (Schumpeter 1934). Commencing from a circular flow of goods and money of a given size in a static context, Schumpeter argued that without growth or economic progress, possibilities do not exist for entrepreneurs to operate. However, if the exogenous circumstances are changing, the circular equilibrium will also change. This disturbance of equilibrium towards a new position has been named as creative destruction. Nijkamp (2000) argues that one of the driving forces of change towards a new equilibrium is formed by innovation, which means a breakthrough of existing patterns of production and productivity. Innovation thus is a creative modus operandi of an entrepreneur and induces a process of economic growth.

In the view of Schumpeter’s innovation and entrepreneurship, the role of entrepreneur is seen as interrelated and can only be understood if placed against the background of his/her theory of innovation. The technological process is increasingly becoming the business of trained specialists who turn out what is required and make it work in predictable ways (Schumpeter 1943). It is identified as contributing to the disappearance of the entrepreneur in capitalism because rationalisation and bureaucratisation had become major trends in modern capitalist society (Schumpeter 1943). A final consequence of these features of modern capitalism is that capitalism evolves towards a socialist society as the bourgeoisie loses its social and ideological defender, personified in the entrepreneur (Schumpeter 1943).

The emerging field of entrepreneurship has also generated considerable attention in the research literature based on its importance to corporate vitality and wealth generation in today’s global economy. Zahra, Kuratko and Jennings (1999) state that entrepreneurship increases national prosperity by impacting on employment creation and the development of new goods and services. It is proposed that entrepreneurship can be used to improve competitive positioning and to transform corporations, their markets and industries as opportunities for value-creating innovations are developed and exploited (Lumpkin & Dess 1996; Naman & Slevin 1993).

Lee and Peterson (2000) argue that entrepreneurship is the main mechanism for transforming global industries. It is believed that higher levels of entrepreneurship are associated with higher levels of global competitiveness, more wealth and affluence, and long-term growth and viability. The reasons for this are the increased value-creating outcomes associated with the successful launch of new products and services and the efficiencies gained through technological advances. There is now a firmly established empirical base for claiming the effectiveness of entrepreneurship in revitalising the profitability and competitiveness of firms, industries and whole nations (Lumpkin & Dess 1996).

2.4.3.3 Entrepreneurial Characteristics and Personality Perspective

Besides the early work of Schumpeter (1934) and other economists who contributed to the literature of entrepreneurship, there have been many studies done on the understanding of entrepreneurial characteristics and personality of the entrepreneurs. Traditionally, the researchers believe that entrepreneurship is very personal and individualist, which is related to the entrepreneur's behaviour, characteristics and personality traits (Baum, Frese, Baron & Katz 2007). The following section will explore how entrepreneurial characteristics and personality perspective studies were done on the entrepreneurship research.

Entrepreneurial Characteristics

In past two decades, there have been numerous research studies exploring the influencing factors of the entrepreneur. A quick summary is given below regarding these studies on new ventures.

Studies were done to examine the characteristics, attitudes and skills, of the founder (McClelland 1987; Perry, Meredith & Cunnington 1988; McGrath & MacMillan 1992; Ray 1993; Stevenson, Grousebeck Roberts & Bhide 1999). Other research themes were done on the relationship between entrepreneurs' characteristics and locus of control and risk tendencies (Brockhaus 1980; Muzyka 1992).

Other investigations have compared in the following topics:

- The characteristics of entrepreneurs with non-entrepreneurs (Carland, Hoy, Boulton & Carland 1984; McGrath & McMillan 1992; McGrath, McMillan & Scheinberg 1992);
- The entrepreneurial typologies (Woo, Cooper & Dunkelberg 1991);
- The characteristics of female entrepreneurs (DeCarlo & Lyons 1979; Hisrich, 1989; Brown & Segal 1989; Still & Guerin 1991); and
- Gender differences (Masters & Meier 1988; Miner, Smith & Bracker 1992).

Other research themes have included these topics too:

- Assessment of the likelihood of success against the relative proactiveness of the founder (Miller & Friesen 1984);
- Study of psychological characteristics (Jones 1983; Begley & Boyd 1987; Rice & Lindecamp 1989; Katz 1992);
- Study of entrepreneurial traits (MacMillan 1986; Gartner 1989; Herron & Robinson 1993);
- Personality types (Hollenbeck & Whitener 1988; Ginn & Sexton 1990; Chell, Haworth & Brearley 1991);
- Learning styles (Bailey 1986);
- Specific examination of problem solving-styles (Naidu & Narayana 1990; Buttner & Gryskiewicz 1993);
- Values systems (Fagenson 1993);

- Motivation and behaviour for a variety of profiles, including the perceptions of entrepreneurs' characteristics (Hamilton 1987; Buttner & Rosen 1988; Dubini 1989);
- Extension of the list of characteristics including desirable attitudes such as aspirations not constrained by current capabilities (Stevenson & Jarillo 1990), a team orientation (Starr & MacMillan 1990), innovativeness (Bhattacharyya 2006) and strategic vision (Westley & Mintzberg 1988).

Much criticism has been levelled at the majority of the research related to the personality attribute approach (Carsrud, Gaglio & Olm 1987; Gartner, 1989; Chell et al. 1991; Timmons, Gillin, Burshtein & Spinelli 2011). The identified weakness of the research has focussed on the lack of definition and weak concept formation; lack of understanding of trait-based psychology and poor definition of the object of study (the entrepreneur), with some studies focussing on the founder and others the owner/manager. All the criticism lends itself to support the view that the decision to become an entrepreneur results from a complex interaction of personal attributes and the situation faced by the individual.

Kuratko and Hodgetts (2007, p. 120) list the top ten characteristics commonly shared in twenty-first century entrepreneurs, which also concurs with the list developed by Timmons, Gillin, Burshtein & Spinelli (2011):

- Recognise and take advantage of opportunities
- Resourceful
- Creative
- Visionary
- Independent thinker
- Hard worker

- Optimistic
- Innovator
- Risk taker
- Leader

Entrepreneurial Personality

The history of research on the relationship between personality and entrepreneurship can be dated back to the research on the relationship of personality traits to leadership (Naffziger 1995). Although it has got some success in investigating the personality traits in the field of entrepreneurship in the early phase, and was followed by a number of papers formulating a critical research perspective on the importance and measurement of personality, the research for entrepreneurial personality has received some criticisms regarding the theory building. That is, explaining why there is strong need for newer research that consists of refined theory development, the integration of research models, and, to some extent, a "comeback" of personality considerations (Rauch & Frese 2000).

Personality traits may be influenced by the unique, tacit, subjective personal knowledge, values/beliefs, perception and experiences of the individual that are not easily replicated (Kor, Mahoney & Micheal 2007). Serving as a catalyst, personality traits of an individual can influences the risk perception of entrepreneurs in decision-making (Chaucin, Hermand & Mullet 2007; Rauch & Frese, 2007). It has been found that proactive personality is a significant predictor, especially of entrepreneurial start-up intentions, but the influence reduces in time as the venture maturates (Crant, 1996; Frank, Lueger & Korunka 2007). Entrepreneurs have been found to possess higher scores of tolerance for ambiguity, internal locus of control, proactive personality, self-efficacy and need for achievement compared with non-entrepreneurs in explaining business success (Cools & Van Den Broeck 2008; Crant 1996; Rauch & Frese 2007).

Over time, the conclusion is that no one particular psychological model has emerged, with successful entrepreneurs comprising a mix of age, gender, background and experience (Churchill & Lewis 1983; Carland et al. 1984; Miner, Smith & Bracker 1992; McGrath, MacMillan & Scheinberg 1992; Timmons, Gillin, Burshtein & Spinelli 2011). However, with the early work on achievement motivation of McClelland (1961a), there is agreement that while there is a core of inborn attributes, such as energy and intelligence, some of the attributes and behaviours typically demonstrated by successful entrepreneurs can also be acquired through experience and learning. This still makes personality traits predictable and enduring characteristics of individual behaviour which assist in explaining the differences of individual actions in similar situations (Llewellyn & Wilson 2003).

Despite the difficulty in finding and researching the entrepreneurial personality traits, a consensus has emerged from Timmons, Gillin, Burshtein and Spinelli (2011, p. 51), on eight dominant themes of desirable and acquirable attitudes and behaviours, as stated in Table 2.12. It shows a very good summary for these eight dominant themes of attitudes and behaviours. A very detailed description of each attitude or behaviour can be found in Timmons, Gillin, Burshtein and Spinelli (2011, pp. 50-60).

Table 2.12 Eight themes of desirable and acquirable attitudes and behaviours

Theme	Attitude or Behaviour
Commitment and determination	Tenacity and decisiveness, able to recommit/commit quickly Intensely competitive in achieving goals Persistence in solving problems, disciplined Willingness to undertake personal sacrifice Immersed in the mission
Courage	Moral strength Fearless experimentation Not afraid of conflicts, failure Intense curiosity in the face of risk
Leadership	Self-starter; high standards but not perfectionist Team builder and hero maker; inspired others Treat others as you want to be treated Share the wealth with all the people who helped to create it Honest and reliable; builds trust; practices fairness Not a lone wolf Superior learner and teacher; courage Patience and urgent
Opportunity Obsession	Leadership in shaping the opportunity Has intimate knowledge of customers' needs and wants Market driven
Tolerance of Risk, Ambiguity and Uncertainty	Obsessed with value creation and enhancement Calculated risk taker Risk minimiser Risk sharer Manages paradoxes and contradictions Tolerance of uncertainty and lack of structure Tolerance of stress and conflict Ability to resolve problems and integrate solutions
Creativity, Self-reliance and adaptability	Nonconventional, open-minded, lateral thinker (helicopter mind) Restlessness with status quo Ability to adapt and change; creative problem solver Quick learner No fear of failure Ability to conceptualise and "sweat details"
Motivation to Excel	Goal and results orientation; high but realistic goals Drive to achieve and grow Low need for status and power Interpersonally supporting (versus competitive) Aware of weaknesses and strengths Has perspective and sense of humour
Intuitive	Passionately committed Detects meaningful patterns Thinks holistically Senses "gut" type feelings Processes non-local information

Source: Adapted from Timmons, Gillin, Burshtein and Spinelli (2011, p. 51)

Bygrave and Hofer (1991) believe that the emerging trend for the act of becoming an entrepreneur involves changing the state of the external environment, requiring the ability to respond continuously to changing contexts. This interaction with resources external to the venture would naturally embrace the need to continuously communicate and form relationships with other individuals. New enterprise creation therefore incorporates both individual characteristics and environmental influences, a model portrayed as an interactive process in which personal characteristics, including personality, interact with an interpretation of relevant events in the environment to influence decisions.

While the role of experience and know-how is central to the successful creation of a new venture, Vesper (1992) believes the most critical factor is the ability of the entrepreneur to gain information and act on it, inferring that contacts and “know who” are integral to knowledge and experience acquisition. Of particular interest to this research is the use of mentors or advisors. Gartner, Shaver, Gatewood and Katz (1994) identified one of the factors contributing to the likelihood of success of an entrepreneur was the amount of time and intensity devoted to specific activities including finding mentors (i.e. helpful non-paid experts). In contrast, the contribution of outside advisors was found to be minimal by Keeley and Kapp (1994). In their sample, founders of successful businesses were drawn by the challenge, the independence and the desire to not simply hold a job. The process of starting the business involved little exploration of options. The founder did not systematically search for a business idea, did not develop a business plan and outside advisors and/or investors played essentially no role in the founder’s choice of business or mode of entry. The importance of on-the-job learning varied. Some had learned about their business from prior industry experience, but others began the company and simply learned as they went. The latter group expressed a greater tendency to rely on outside advisors/mentors, but generally after the formation of the business.

Vesper (1994) concurs that studies of psychological attributes have generally proven inconclusive.

2.4.3.4 Process Perspective - Entrepreneurial Process Model

Bygrave and Hofer (1991) identify the inability for researchers to agree on a definition of entrepreneurship and the definition of an entrepreneur. They recommend a shift from the traditional focus on the characteristics and functions of the entrepreneur to a focus on the nature and characteristics of the entrepreneurial process. In the process perspective, some common themes have emerged around the concept of *opportunity* as a central element in the process (Eckhardt & Shane 2003; Shane & Venkataraman 2000; Hills, Lumpkin & Singh 1997; Venkataraman 1997; Kirzner 1979). Opportunities are recognised by entrepreneurs in various ways that are not yet well understood and are acted on, or exploited, by the entrepreneur or by others to whom the opportunity is sold or transferred. The following sections only summarise the entrepreneurial process model. More detailed discussion can be referred to Chapter 3.

Bygrave and Hofer (1991, p. 14) provide such description about the definition of the entrepreneurial process. It is one which "involves all the functions, activities, and actions associated with the perceiving of opportunities and the creation of organisations to pursue them". An entrepreneurial event is one which "involves the creation of a new organisation to pursue an opportunity' (Bygrave & Hofer 1991, p. 14). Based on these two definitions, Bygrave and Hofer (1991, p. 14) propose that it is then possible to define an entrepreneur as "someone who perceives an opportunity and creates an organisation to pursue it". From this combined definition, entrepreneurship is perceived as holistic, that is, it is a relationship of the business and its founder(s)/managers. Entrepreneurship is creating and building something of value from practically nothing. That is, entrepreneurship is the process of creating or seizing an opportunity and pursuing it regardless of the resources currently controlled. Entrepreneurship is holistic and integrated; that is, entrepreneurship concerns the business and its managers/founders in their entirety, not just piecemeal (Timmons, Gillin, Burshtein & Spinelli 2011).

<u>What is Opportunity?</u>

In the eyes of Austrian economics, opportunities are arbitrage opportunities, that is, a market situation in which prices are not properly matched among buyers and sellers and there is an opportunity to buy at a low price and sell at a higher one and earn supernormal profits (Shane & Venkataraman 2000). Another definition given by other scholars is as a desirable future state that is different from the current state and which is deemed feasible to achieve (Stevenson & Jarillo 1990). Casson (1982) defines it as situations to bring into existence new goods, services, raw materials and organising methods that allow outputs to be sold at more than their cost of production. Christensen (2000, p. 45) defines opportunity as "a possibility to create a new business unit or strengthening the position of an existing one making it more profitable". Opportunities are essentially different ways to innovate to make profits or improve the state of affairs of a person or firm, and different types of opportunities may be traced back to the five types identified by Schumpeter described above in section 2.4.3.1.

Based on prior work, entrepreneurial opportunities can be conceptualised as a subset of *all* possible opportunities. Entrepreneurial opportunities require the creation or identification of new means–ends frameworks or relationships (Kirzner 1997). They are characterised by (1) creative decisions, because the entrepreneur has to construct the means, the ends, or both (Eckhardt & Shane 2003), and (2) an uncertain set of alternatives and consequences (Knight 1921).

Following this perspective, the definition of entrepreneurial opportunity from Eckhardt and Shane (2003, p. 336) is adopted here:

> "situations in which new goods, services, raw materials, markets and organizing methods can be introduced through the formation of new means, ends or means–ends relationships".

However, non-entrepreneurial opportunity involves incremental change or refinement of an existing product, process or market position; it involves manipulating within previously established means–ends frameworks (Kirzner 1997). Purchasing a large supply of raw materials that suddenly become available at very low price, or reorganising by outsourcing production capability to reduce costs, are examples of non-entrepreneurial opportunities (Lumpkin & Dess 1996). Also, buying a lottery ticket or speculating in stock markets does not fall within the definition of entrepreneurial opportunity because they do not lead to new means-ends relations. But the opportunities to form a new venture (Gartner, 1990; Low & MacMillan 1988), to create or extend a new product/brand, or to enter the international markets (Davidsson 2004), regardless of the modes of entry, are considered entrepreneurial.

Development of Entrepreneurial Process Model

Shane (2003) claims to provide the first exhaustive account of the theory of entrepreneurship in the last twenty years by offering an overarching conceptual framework that explains the different parts of the entrepreneurial process in a coherent way. His approach is a significant contribution to a theoretical understanding of the phenomenon of primary entrepreneurship as it is directed towards the relationship between the individual and the opportunity that endures survival, growth and profitability to build on the experience gained in an initial public offering. The steps in understanding how the “who” and the “why” are inter-related through the processes of discovery, evaluation and exploitation of opportunities provides a substantial measure of integration to an understanding of the “what” and “when” of the phenomenon of entrepreneurship. This whole-process approach integrates the opportunities, the people who pursue them, the skills and strategies used to organise and exploit opportunities and the environmental conditions favourable to them.

Shane (2003) argues that neither the environment-centric nor the individual-centric approaches to explanation of the phenomenon of entrepreneurship provide more than half of the understanding of the processes involved in the field (Shane 2003). Instead, he observes that readers will note that any effort to provide a conceptual framework for entrepreneurship seems to require an interdisciplinary approach. The domains of psychology, sociology and economics all seem to provide insight into a piece of the puzzle, but none seem to explain the phenomenon completely. (Shane 2003, p. 10)

The “individual-opportunity” nexus proposed as the basis of his general theory of entrepreneurship is based upon the definition of entrepreneurship provided by Shane and Venkataraman (2000) as an activity that involves the discovery, evaluation and exploitation of opportunities to introduce new goods and services, ways of organising markets, processes and raw materials through organising efforts that previously had not existed. The central premise of this theory is that entrepreneurship can be explained by considering the nexus of enterprising individuals and valuable opportunities and by using that nexus to understand the process of discovery and exploitation of opportunities, the acquisition of resources, entrepreneurial strategy and the organising process (Shane 2003).

Two operational definitions of entrepreneurship include self-employment as performing work for personal profit rather than for wages paid by others (Le 1999) and the founding of a new business as the forming of a new business venture or not-for-profit organisation that previously was not in existence (Shane 2003).

According to Shane's (2003) proposition, the differences in people's cognitive processes influence their ability to identify the new means-ends frameworks necessary for opportunity discovery that is taken as the most important contribution to the “how” of entrepreneurship (Shane 2003).

As Davidsson (2004) notes, Shane's theory directs attention to the problem of emergence, an element that is missing in most established theories in economics and management. Nevertheless, it leaves open explanations of the pattern of interactions between the individual and the opportunity on the one hand, and the interactions between the opportunity and the environment on the other. Shane's general theory (2003) focus remains with the primary and secondary entrepreneurship operations of the entrepreneur and takes self-employment or the entry of new independent businesses as the operationalisation of entrepreneurship (Davidsson 2004).

In brief, Shane's (2003) contribution to theory development of the entrepreneurial process model to date includes the awareness and alertness to opportunity, discovery of the opportunity, decisions to exploit opportunity, resource acquisition, entrepreneurial strategy, organising process and measures of performance.

Many existing entrepreneurial process models are different in many respects. However, Shane’s (2003) process model has gained a lot of attention, as summarised very briefly below. The following sequence or step proposed by Shane (2003) may be different with the other researcher's process model.

1. The emergence of opportunities (derived from changing economic, technological, and social conditions
2. Recognition of these opportunities by specific persons
3. Evaluation of these opportunities coupled with an active decision to pursue them
4. Assembly of required resources
5. Development of strategy for using these resources to exploit the opportunity
6. Actual exploitation.

More detailed discussion for the entrepreneurial process model can be referred to Chapter 3.

2.4.4 Entrepreneurship in Australia

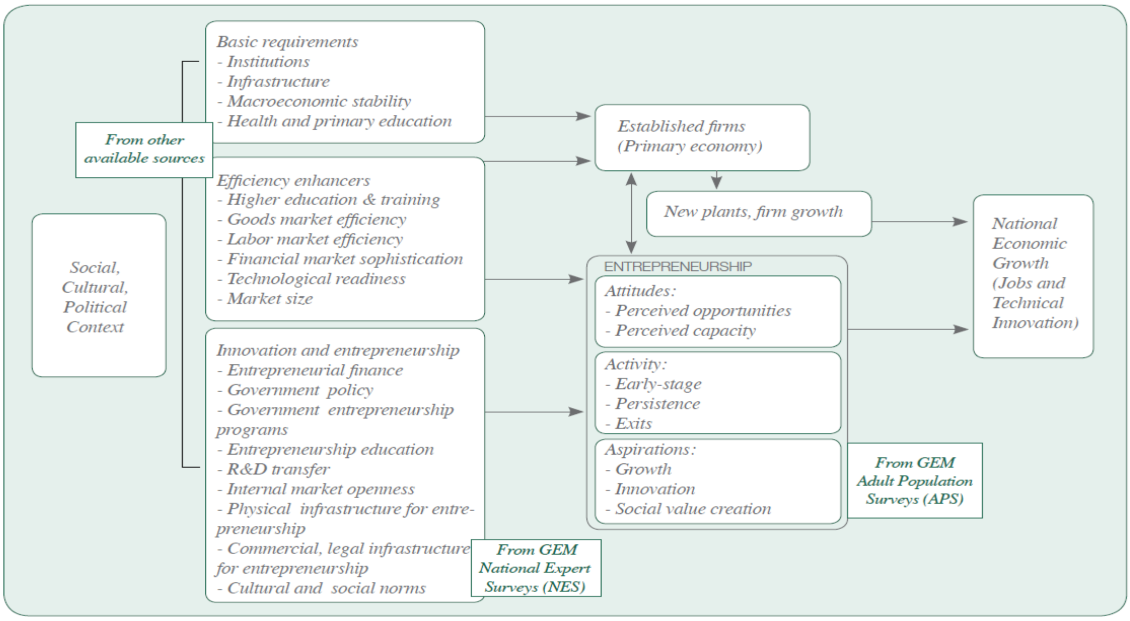
Despite entrepreneurship becoming the indicator for business tenacity and achievement, Australia is still facing a lot of issues in implementing this discipline. It is very hard to find the national statistics of the entrepreneurial activities published by Australian organisations or government. However, the national information for the situation of entrepreneurship in Australia can be sourced through the Global Report of Global Entrepreneurship Monitor (GEM) research program which is an annual global harmonised assessment of the national level of entrepreneurial activity for the participating countries, involving exploration of the role of entrepreneurship in national economic growth (GERA 2010). Figure 2.5 describes the conceptual model employed by the GEM research program as stated in GEM 2010 Global Report (Kelley, Bosma & Amoros 2011). The GEM model illustrates as

> "first, the relationship between the social, cultural and political context and three sets of framework conditions. These framework conditions are modeled as impacting the attitudes of a population toward entrepreneurship, and the activity and aspirations of entrepreneurs. In turn, entrepreneurship activity, as well as the growth of established firms in the primary economy, influence economic growth" (Kelley, Bosma & Amoros 2011).

In this section for the discussion of GEM model, only the aspects of attitudes, activity and aspirations of entrepreneurship are addressed.

The GEM model follows the classification of World Economic Forum's (WEF) Global Competitiveness Report (Schwab 2010) by grouping the participating economies into three levels: factor-driven, efficiency-driven, and innovation-driven. These three levels of groupings determine phases of economic development based on GDP per capita and the share of exports including primary goods. The factor-driven economies are characterised by labour-intensive agriculture and natural resource-based extraction businesses. In the second phase of efficiency-driven economies, the dominating phenomena are the industrialisation, heavy reliance on economies of scale and capital-intensive large organisations while the businesses are more knowledge-intensive and services oriented in phase three of innovation-driven economies (Schwab 2010).

Figure 2.5 Global Entrepreneurship Monitor (GEM) conceptual model



Source: Kelley, Bosma & Amoros (2011)

Entrepreneurial attitudes refer to the general feelings of a population toward entrepreneurs and entrepreneurship. If the economy in general has positive attitudes toward entrepreneurship by recognising valuable business opportunities and having the skills for opportunity exploitation, various forms of assistance such as financial resources, cultural support and networking benefits will be provided to existing and potential entrepreneurs. Perceptions are measured as career choice, social status of entrepreneurs, media image of entrepreneur and entrepreneurial intention to start a new business.

Table 2.13 describes the entrepreneurial attitudes and perceptions for Australia as an innovation-driven economy in the 2010 GEM report (Kelley, Bosma & Amoros 2011). In the entrepreneurial attitudes of innovation-driven economy, Australia is positioned as quite average among the affluent countries. Australia was in the middle between Nordic regions (high) and southern Europe (low) in the category of opportunity and capability perception. Australian entrepreneurs are having high attention in media coverage and reasonably high social status.

GEM defines Total Early-Stage Entrepreneurship Activity (TEA) as "the prevalence rate of individuals in the working-age population who are actively involved in business start-ups, either in the phase preceding the birth of the firm (nascent entrepreneurs), or the phase spanning 3½ years after the birth of the firm (owner-managers of new firms)" (Kelley, Bosma & Amoros 2011). In Table 2.14, the entrepreneurial activities are measured as the nascent entrepreneur rate, new business ownership rate, TEA, established business ownership rate, discontinuation of business, necessity-driven opportunity and improvement-driven opportunity.

Table 2.13 Entrepreneurial attitudes and perceptions for Australia as innovation-driven economy in the 2010 GEM report

	Perceived Opportunities	Perceived Capabilities	Fear of Failure*	Entrepreneurship as a Good Career Choice	High Status to Successful Entrepreneurs	Media Attention for Entrepreneurship	Entrepreneurial Intentions **
Factor-Driven Economies							
Angola	67.3	73.1	32.2	70.1	83.3	74.7	54.5
Bolivia	53.2	75.8	28.4	62.9	66.6	51.1	49.3
Egypt	38.8	63.4	25.3	77.7	89.5	70.5	24.3
Ghana	75.7	74.6	10.4	91.1	90.7	78.6	68.8
Guatemala	62.9	71.0	23.2	73.8	59.7	44.1	30.7
Iran	41.6	65.7	30.1	63.6	84.6	62.3	31.4
Jamaica	56.1	80.2	33.0	85.1	84.8	77.4	38.1
Pakistan	51.9	56.2	34.3	76.3	80.7	61.0	32.4
Saudi Arabia	75.8	69.3	39.0	86.8	92.3	78.0	1.0
Uganda	80.5	86.7	20.7	81.1	87.3	81.9	77.1
Vanuatu	73.6	79.6	46.9	55.6	77.6	34.3	50.5
West Bank and Gaza Strip	44.0	57.0	40.0	85.3	83.5	62.5	28.2
Zambia	81.4	77.5	12.8	69.9	71.8	72.5	67.1
Average (unweighted)	61.8	71.5	28.9	75.3	80.9	65.3	42.6
Efficiency-Driven Economies							
Argentina	50.3	63.5	21.3	74.3	67.1	61.7	21.0
Bosnia and Herzegovina	38.3	62.5	27.4	76.0	63.0	47.6	16.8
Brazil	48.1	57.9	33.2	78.0	79.0	81.1	26.5
Chile	65.0	65.6	22.1	87.4	71.2	45.7	38.3
China	36.2	42.3	32.0	70.0	76.9	77.0	26.9
Colombia	68.2	65.1	27.7	88.6	75.9	66.7	41.3
Costa Rica	46.4	68.8	36.0	64.3	63.4	60.8	13.2
Croatia	23.3	53.2	31.2	67.1	49.9	41.8	7.4
Ecuador	50.3	76.6	31.2	83.1	74.0	62.6	46.3
Hungary	33.3	43.4	42.4	55.0	73.7	47.4	13.8
Latvia	29.1	50.7	39.9	58.8	64.8	57.2	21.4
Macedonia	34.3	59.7	30.9	71.3	66.2	56.0	26.7
Malaysia	40.1	24.3	45.3	55.7	68.6	88.0	5.1
Mexico	55.6	64.6	33.4	69.4	62.8	54.0	22.3
Montenegro	36.1	70.9	30.4	81.0	68.4	69.5	31.9
Peru	71.4	76.5	34.0	82.0	76.8	81.2	39.6
Romania	17.5	38.2	41.1	66.5	65.5	46.9	8.6
Russia	21.7	22.7	41.7	65.4	63.7	46.6	2.6
South Africa	40.9	44.3	29.0	77.5	77.6	78.6	16.7
Taiwan	29.6	26.4	43.8	68.4	57.5	78.2	25.1
Trinidad and Tobago	69.1	82.8	11.6	83.2	77.6	67.2	30.4
Tunisia	37.6	53.1	23.2	89.1	92.7	78.4	24.1
Turkey	36.1	54.2	25.0	71.2	76.4	61.7	19.4
Uruguay	52.1	73.3	27.7	64.8	61.8	43.3	31.8
Average (unweighted)	42.9	55.9	31.7	72.8	69.8	62.5	23.2
Innovation-Driven Economies							
Australia	45.7	53.2	35.8	57.0	68.4	70.5	8.7
Belgium	39.6	44.9	35.1	60.0	51.2	45.7	8.2
Denmark	46.4	40.7	31.5	***	***	***	5.9
Finland	51.1	39.5	28.6	46.1	86.5	71.4	5.9
France	33.9	37.3	40.5	65.2	67.9	44.7	14.2
Germany	28.5	41.6	33.7	53.1	77.1	49.0	6.4
Greece	15.9	52.2	50.9	65.6	70.2	34.5	12.8
Iceland	48.7	49.0	33.7	51.2	60.9	66.6	15.7
Ireland	22.5	49.2	33.4	51.8	81.5	61.1	6.1
Israel	35.2	41.6	46.0	61.3	73.0	56.3	14.1
Italy	24.7	42.4	36.8	69.1	69.3	37.7	4.0
Japan	5.9	13.7	32.6	28.4	52.0	58.5	2.9
Republic of Korea	13.0	29.0	32.5	67.6	71.3	61.4	10.1
Netherlands	44.8	45.5	23.8	85.4	68.6	60.9	5.5
Norway	49.8	40.4	26.6	57.8	70.7	67.2	7.6
Portugal	20.3	52.1	29.7	67.5	70.5	52.6	8.8
Slovenia	26.8	56.3	27.5	53.2	73.7	56.2	8.7
Spain	18.8	50.2	36.4	65.4	62.5	40.7	5.8
Sweden	66.1	42.4	28.9	56.9	71.6	60.8	8.5
Switzerland	33.3	43.9	27.0	64.9	76.4	50.6	6.7
United Kingdom	29.2	51.8	30.3	51.0	76.7	52.2	5.1
United States	34.8	59.5	26.7	65.4	75.9	67.8	7.7
Average (unweighted)	33.4	44.4	33.1	59.2	70.3	55.5	8.2

* Denominator: 18–64 age group perceiving good opportunities to start a business.
** Denominator: 18–64 age group that is not involved in entrepreneurship activity.
*** Data is not available

Source: Kelley, Bosma & Amoros (2011)

Table 2.14 Entrepreneurial activities for Australia as innovation-driven economy in the 2010 GEM report

	Nascent Entrepreneurship Rate	*New Business Ownership Rate*	*Total Early-Stage Entrepreneurship Activity (TEA)*	*Established Business Ownership Rate*	*Discontinuation of Businesses*	*Necessity-Driven (% of TEA)*	*Improvement-Driven Opportunity (% of TEA)*
Factor-Driven Economies							
Angola	*13.6*	*19.1*	*32.4*	*8.6*	*19.9*	*36*	*30*
Bolivia	*28.8*	*14.0*	*38.6*	*18.2*	*9.0*	*17*	*57*
Egypt	*2.1*	*4.9*	*7.0*	*4.5*	*3.8*	*53*	*25*
Ghana	*10.7*	*24.6*	*33.9*	*35.5*	*25.7*	*37*	*35*
Guatemala	*8.3*	*8.4*	*16.3*	*6.6*	*3.9*	*15*	*28*
Iran	*4.8*	*7.8*	*12.4*	*12.2*	*7.3*	*38*	*39*
Jamaica	*5.5*	*5.1*	*10.5*	*6.9*	*8.1*	*42*	*39*
Pakistan	*6.6*	*2.7*	*9.1*	*4.7*	*2.6*	*41*	*39*
Saudi Arabia	*5.9*	*3.5*	*9.4*	*3.9*	*3.8*	*10*	*75*
Uganda	*10.6*	*22.0*	*31.3*	*27.7*	*27.4*	*50*	*34*
Vanuatu	*31.2*	*28.2*	*52.2*	*23.2*	*22.0*	*38*	*24*
West Bank and Gaza Strip	*7.9*	*2.6*	*10.4*	*2.0*	*5.7*	*32*	*33*
Zambia	*17.3*	*17.1*	*32.6*	*9.6*	*23.5*	*32*	*41*
Average (unweighted)	*11.8*	*12.3*	*22.8*	*12.6*	*12.5*	*34*	*38*
	Nascent Entrepreneurship Rate	*New Business Ownership Rate*	*Total Early-Stage Entrepreneurship Activity (TEA)*	*Established Business Ownership Rate*	*Discontinuation of Businesses*	*Necessity-Driven (% of TEA)*	*Improvement-Driven Opportunity (% of TEA)*
Efficiency-Driven Economies							
Argentina	*7.0*	*7.4*	*14.2*	*12.4*	*3.8*	*36*	*43*
Bosnia and Herzegovina	*4.1*	*4.1*	*7.7*	*6.6*	*4.7*	*47*	*30*
Brazil	*5.8*	*11.8*	*17.5*	*15.3*	*5.3*	*31*	*46*
Chile	*11.1*	*6.1*	*16.8*	*6.0*	*5.6*	*29*	*53*
China	*4.6*	*10.0*	*14.4*	*13.8*	*5.6*	*42*	*34*
Colombia	*8.6*	*12.7*	*20.6*	*12.2*	*5.1*	*40*	*41*
Costa Rica	*10.4*	*3.6*	*13.5*	*4.8*	*2.0*	*32*	*38*
Croatia	*3.8*	*1.9*	*5.5*	*2.9*	*4.5*	*32*	*49*
Ecuador	*10.4*	*11.5*	*21.3*	*14.7*	*7.2*	*28*	*45*
Hungary	*4.6*	*2.6*	*7.1*	*5.4*	*2.9*	*20*	*43*
Latvia	*5.6*	*4.2*	*9.7*	*7.6*	*4.2*	*27*	*51*
Macedonia	*4.4*	*3.6*	*8.0*	*7.6*	*3.7*	*59*	*23*
Malaysia	*1.4*	*3.6*	*5.0*	*7.9*	*1.9*	*12*	*41*
Mexico	*	*	*	*	*5.9*	*	*
Montenegro	*12.0*	*3.1*	*14.9*	*7.8*	*7.3*	*37*	*38*
Peru	*22.1*	*6.0*	*27.2*	*7.2*	*9.2*	*21*	*47*
Romania	*3.3*	*1.1*	*4.3*	*2.1*	*2.6*	*31*	*47*
Russia	*2.1*	*1.9*	*3.9*	*2.8*	*0.8*	*32*	*30*
South Africa	*5.1*	*3.9*	*8.9*	*2.1*	*4.8*	*36*	*31*
Taiwan	*4.7*	*3.8*	*8.4*	*7.2*	*3.7*	*30*	*48*
Trinidad and Tobago	*8.9*	*6.4*	*15.1*	*8.5*	*2.9*	*14*	*47*
Tunisia	*1.7*	*4.4*	*6.1*	*9.0*	*4.1*	*24*	*48*
Turkey	*3.7*	*5.1*	*8.6*	*10.7*	*4.6*	*37*	*47*
Uruguay	*7.8*	*4.1*	*11.7*	*7.2*	*3.5*	*26*	*54*
Average (unweighted)	*6.7*	*5.2*	*11.7*	*7.6*	*4.4*	*31*	*42*
Innovation-Driven Economies							
Australia	*3.9*	*4.0*	*7.8*	*8.5*	*2.7*	*19*	*59*
Belgium	*2.3*	*1.4*	*3.7*	*2.7*	*2.0*	*10*	*54*
Denmark	*1.8*	*2.2*	*3.8*	*5.6*	*1.7*	*8*	*54*
Finland	*2.4*	*3.4*	*5.7*	*9.4*	*1.8*	*18*	*54*
France	*3.7*	*2.3*	*5.8*	*2.4*	*2.5*	*25*	*56*
Germany	*2.5*	*1.8*	*4.2*	*5.7*	*1.5*	*26*	*48*
Greece	*2.0*	*3.5*	*5.5*	*14.8*	*3.4*	*28*	*39*
Iceland	*7.4*	*3.3*	*10.6*	*7.4*	*3.4*	*7*	*68*
Ireland	*4.4*	*2.6*	*6.8*	*8.6*	*2.3*	*31*	*33*
Israel	*3.2*	*2.6*	*5.7*	*3.1*	*3.8*	*29*	*54*
Italy	*1.3*	*1.0*	*2.3*	*3.7*	*1.6*	*13*	*55*
Japan	*1.5*	*1.8*	*3.3*	*7.4*	*1.5*	*36*	*47*
Republic of Korea	*1.8*	*4.8*	*6.6*	*11.2*	*1.6*	*39*	*49*
Netherlands	*4.0*	*3.4*	*7.2*	*9.0*	*1.4*	*8*	*64*
Norway	*4.4*	*3.4*	*7.7*	*6.7*	*2.6*	*15*	*74*
Portugal	*1.8*	*2.8*	*4.5*	*5.4*	*2.6*	*22*	*52*
Slovenia	*2.2*	*2.4*	*4.7*	*4.9*	*1.6*	*16*	*54*
Spain	*2.2*	*2.1*	*4.3*	*7.7*	*1.9*	*25*	*42*
Sweden	*2.3*	*2.6*	*4.9*	*6.4*	*2.9*	*13*	*72*
Switzerland	*2.0*	*3.1*	*5.0*	*8.7*	*2.4*	*14*	*60*
United Kingdom	*3.2*	*3.3*	*6.4*	*6.4*	*1.8*	*11*	*43*
United States	*4.8*	*2.8*	*7.6*	*7.7*	*3.8*	*28*	*51*
Average (unweighted)	*3.0*	*2.8*	*5.6*	*7.0*	*2.3*	*20*	*54*

* Data is not available

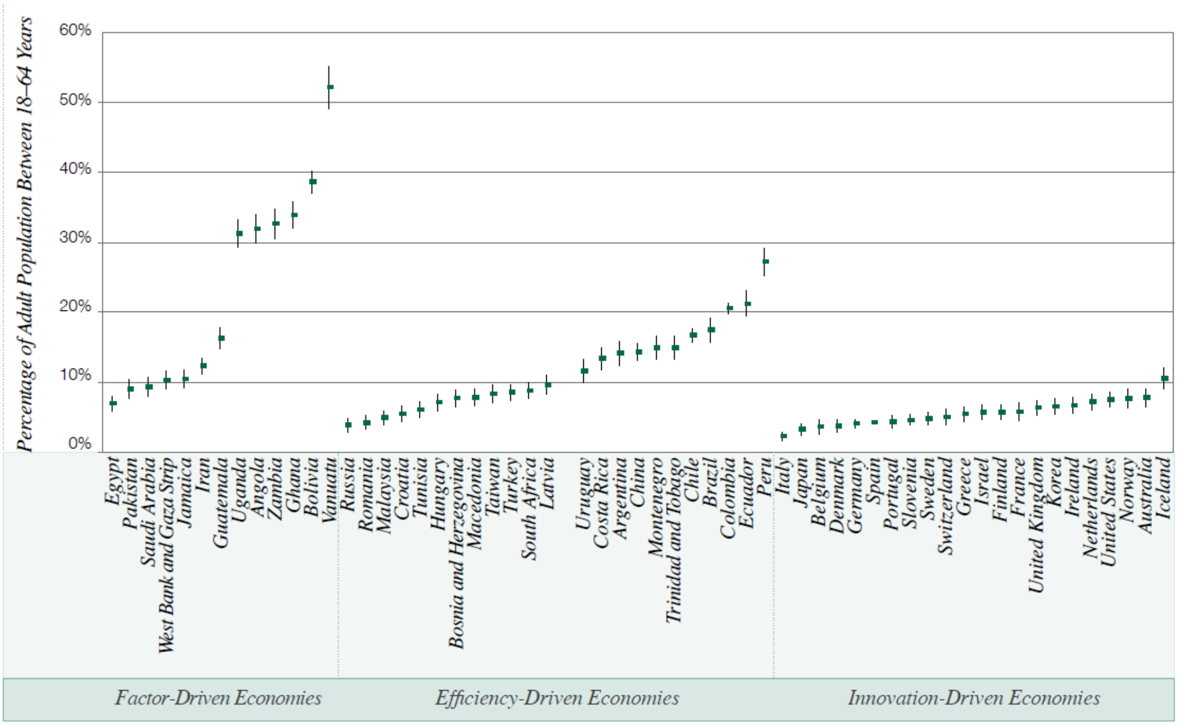
Source: Kelley, Bosma & Amoros (2011)

In Table 2.14, Australia is generally positioned as quite average in the entrepreneurial activity in the innovation-driven economies. Australia, like USA and Iceland showed the highest TEA rates among the innovation economies. Australia (mean=8.5) had higher established business ownership rate than USA (mean=7.7) and UK (mean=6.4) while Australia (mean=2.7) was in between USA (mean=3.8) and UK (mean=1.8) for the discontinuation of businesses in the innovation-driven economies.

Figures 2.6 and 2.7 display the position of Australia in total early stage entrepreneurial activity (TEA) and established activity for 59 economies in the 2010 GEM report. It is very interesting to observe that a higher percentage of the Australian adult population between 18-64 years participated in early stage entrepreneurial activity (TEA) and established activity for 59 economies than UK and USA. Mostly, UK had lower TEA and established activity among the 59 economies, including UK, USA and Australia.

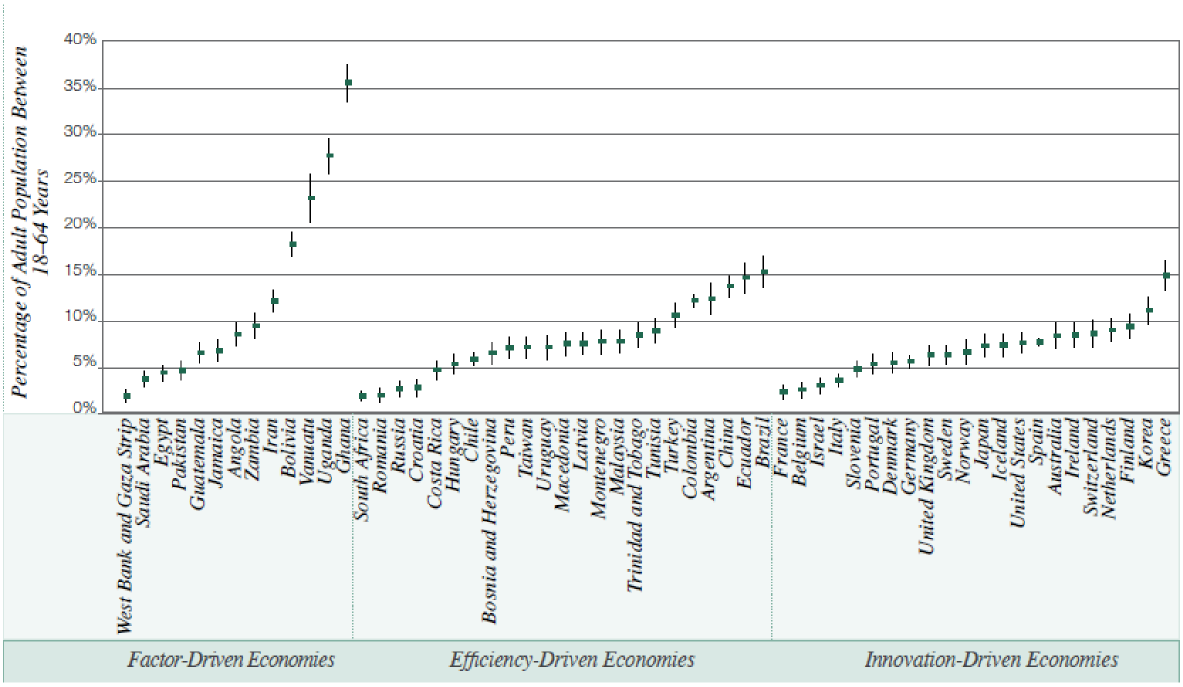
Entrepreneurial aspirations for businesses are different in level among varieties of entrepreneurs who may have particular beliefs or ambitions about the growth prospects for their ventures. Some entrepreneurs may have different intentions in targeting domestic or international markets with their products and services. The employment growth and comparative advantage of their economies are influenced by these entrepreneurs having different ambitions for market penetration. However, no data are provided for Australia's position regarding entrepreneurial aspirations.

Figure 2.6 The position of Australia in total early stage entrepreneurial activity (TEA) in the 2010 GEM report



Source: Kelley, Bosma & Amoros (2011)

Figure 2.7 The position of Australia in established activity for 59 economies in the 2010 GEM report



Source: Kelley, Bosma & Amoros (2011)

On the other hand, Hindle and Rushworth (2002) wrote an entrepreneurship policy report commissioned by the Queensland Government. As Australia was part of the Global Entrepreneurship Monitor (GEM) research project on the study of complex relationship between entrepreneurship and economic growth, annual entrepreneurial activity data has been collected throughout Australia and compared to other countries. In their national study of Australian entrepreneurial activities, the following areas have been identified to focus on in the promotion of entrepreneurship (Hindle & Rushworth 2002, p. 21).

> "In both years of conducting the Global Entrepreneurship Monitor research in Australia the same four areas of concern emerged:
>
> - Culture: Australian culture supports "having a go", but does not respect high ambitions and takes some pleasure in seeing the successful stumble ("tall poppy syndrome"). Furthermore, a professional or corporate career still has higher status and prestige than starting a business for most Australians.
> - Education: There is concern that Australia is not investing enough in education and that standards are declining. The culture among education providers does not generally support entrepreneurial spirit and there are not enough courses in the specific skills needed by entrepreneurs.
> - Government support: Government interest in entrepreneurship has increased but understanding may still be superficial, and support transient. With a few exceptions, little of the interest and support has yet translated into effective programs.
> - Access to capital: The amount of risk capital available has increased, but early stage and patient capital remain problem areas. Many

> entrepreneurs do not understand the investor viewpoint and are therefore ineffective in raising finance (also an education issue)."

Although entrepreneurship policy is a relatively new area in Australia and there has been little research on its effectiveness, Hindle & Rushworth (2002, p. 29) proposed a possible framework for policy development as stated in Table 2.15. They describe an impact model which gives an organised and rational structure for assisting policy makers with a matrix of key relationships. This model can also be applied in high-technology industry such as the Australian biotechnology industry.

Basically, the rows in the matrix are the actors and the columns are the receivers of that action. Each cell word or phrase fundamentally answers the question: "From an entrepreneurship policy perspective, what is the most important impact of this actor on this recipient?" By asking such a basic question, the specific policy problems and issues can be sharply focussed without losing sight of total context. This policy matrix is a quite useful tool in applying to a lot of scenarios of entrepreneurship policy-making. In the policy-making process for promoting entrepreneurship in any city or country, foreseeable policy problems can be determined through use of this policy matrix.

Table 2.15 The Entrepreneurship Policy Matrix Model applied in biotechnology industry

	Individuals at large	Firms in general	Industry in general	Government sector	Society at large
Industrial entrepreneurs	Role models	Challenge	Leadership	Taxes	Inspiration
Entrepreneurial firms	Employment	Role models	Renaissance	Taxes	Applied innovation
Entrepreneurial industries	Affiliation	Networks	Role models	Strategy	Feasibility
Entrepreneurial governments	Capacity: Education	Capacity: Infrastructure	Capacity: Horizon	Capacity: Role models	Value
The entrepreneurial society	Motivation	Choice	Challenge	Priorities	Diversity

Source: Hindle & Rushworth (2002, p. 29)

For example, if you ask the question, "What is the most important impact that an entrepreneurial industry like biotechnology can provide to industry in general?" By going through the matrix, it gives the answer: "role models" (highlighted). The entrepreneurial biotechnology industry provides the individual industry with the role model that they can learn from for competitive strategy formulation in winning the competition with research and development, innovation, entrepreneurship and leadership. In addition, if you ask anther question, "What is the most important impact that industry entrepreneurs from the biotechnology sector can provide to industry in general?" The obvious answer in the policy matrix is "leadership" (highlighted). The biotechnology entrepreneur provides their individual industry with the appropriate leadership style with talent, capabilities and skills as the competitive advantages to influence the competition in terms of (R&D), innovation, and entrepreneurship.

Since entrepreneurship is recognised as a "young field" in its early stages of theory development, those same issues struggled with by entrepreneurship scholars would have been faced by the leadership scholars before. Learning the lessons from the path of leadership research can possibly lessen the growing pains for scholars in entrepreneurship research (Cogliser & Brigham 2004). Moreover, extensive literature has also demonstrated that leadership plays an important role in improving company performance by involving these elements in the defined scope (Hemlin 2006; García-Morales, Lloréns-Montes & Verdú-Jover 2008; Schneider 2002; Ensley, Hmieleski & Pearce 2006; Tarabishy, Solomon, Fernald Jr. & Sashkin 2005). Some of the elements are interrelated.

In this entrepreneurship policy matrix (Hindle & Rushworth 2002), it provides the rationale for how important leadership is in the study of entrepreneurship, which is also incorporated in this new conceptual model development in this thesis. This implies that the entrepreneur has a critical role in demonstrating his/her leadership to embrace entrepreneurship and leadership to win competition and growth of venture. This leadership is referred as the "entrepreneurial leadership capacity (ELC)".

For those successful high-technology organisations such as biotechnology companies, studies have demonstrated that the primary inhibitors to progress in biotechnology, other than technology factors (Tweed and McGregor, 2004), comprised the co-importance of entrepreneurial leadership capacity or skills as well as product ideas and/or technology (Foller 2002), the influence of leadership on creative knowledge environments for research groups (Hemlin 2006), and the lack of leadership. Section 2.5.6 and Chapter 3 will have more detailed discussion for this ELC in the conceptual model. This leads to a discussion of the importance of entrepreneurial leadership in the study of entrepreneurship in the next section.

2.5 Overview of Leadership Capacity and Entrepreneurial Leadership Frameworks

In this overview section, the following will be discussed: the review of leadership theories, the leadership capacity framework, the scope of entrepreneurial leadership; the intersection of entrepreneurship and leadership; leadership skills, behaviour and styles; and the significance of ELC to entrepreneurial biotechnology industry.

2.5.1 Review of Leadership Theories

Throughout the development of management theories, the leadership phenomenon has continued to receive much attention as the most researched discipline but there are great differences in opinion, theories and research results (Paul, Costley, Howell & Dorfman 2002; Northouse 2007). Leadership plays a crucial role in impacting organisational change and to leading innovation and organisational culture (Kotter & Heskett, 1992; Bass 1998; Schein 1992; Brown 1992). Besides, in the development and maintenance of values and excellence, leaders are being recognised having the pivotal roles in organisations (Peters & Waterman 1982). As a result, measurement of leadership has become of critical importance in organisation performance.

Definition of Leadership

According to Simonton (1994, p. 411), leadership can be defined as “the ability of an individual to influence, motivate, and enable others to contribute toward the effectiveness and success of the organisations of which they are members” (Simonton 1994, p. 411).

Many scholars have provided various definitions of leadership, shown in Table 2.16, which obviously appear to have little else in common (Yukl 2002, p. 3). Most definitions of leadership reflect the assumption that it covers a process whereby intentional influence is exerted by one person over other people to guide, structure, and facilitate activities and relationships in a group or organisation. However, the differences in definitions can be found in many aspects, for example, the person who exerts influence, the result of the influence attempt, the manner in which influence is exerted and the purpose of the influence etc.

Table 2.16 Various definitions of leadership

	Author(s)	Definition of leadership
1	House et al.(1999, p. 184)	Leadership is "the ability of an individual to influence, motivate, and enable others to contribute toward the effectiveness and success of the organisation..."
2	Drath & Palus (1994, p. 4)	"Leadership is the process of making sense of what people are doing together so that people will understand and be committed"
3	Schein (1992, p. 2)	Leadership "is the ability to step outside the culture...to start evolutionary change processes that are more adaptive"
4	Jacobs & Jaques, (1990, p. 281)	"Leadership is a process of giving purpose (meaningful direction) to collective effort, and causing willing effort to be expended to achieve purpose"
5	Richards & Engle, (1986, p. 206)	"Leadership is about articulating vision, embodying value, and creating the environment within which things can be accomplished"
6	Rauch & Behling . 1984, p. 46)	Leadership is "the process of influencing the activities of an organised group toward gold achievement"
7	Burns (1978, p. 18)	"Leadership is exercised when persons...mobilise...institutional, political, psychological, and other resources so as to arouse, engage, and satisfy the motives of followers"
8	Katz & Kahn(1978, p. 528)	Leadership is "the influential increment over and above mechanical compliance with the routine directive of the organisation"
9	Hemphill & Coons (1957 , p. 7)	Leadership is "the behaviour of an individual...directing the activities of a group toward a shared goal"

Source: Adopted from Yukl (2002, p. 3)

2.5.1.1 Contemporary Leadership Theories

In the literature, many contemporary ideas and theories of leadership have been developed such as leadership styles, leader behaviours and characteristics, the relationship between leadership and organisational effectiveness etc. Over this period, the output of leadership research throughout the world has posited many different theories about leadership. For the purpose of gaining a robust understanding of leadership in this thesis, the following general and broad categories are discussed (Yukl 2002; Dubrin, Dalglish & Miller 2006; Northouse 2007): trait theories, behavioural approaches, transformational leadership and emotional intelligence.

A. <u>Trait Theories of Leadership</u>

Since early in the 20th century, definitions of leadership were centred around the traits, attributes and internal qualities of leaders (Horner 1997). These trait theories were first put forward by Sir Francis Galton in 1860, and gained prominence during and after World War II (Gibson & Marcoulides 1995). An assumption underlying the trait or personality theory of leadership is that leaders are born and not made. In general, these theories looked at the personal, and then focused on the biological characteristics of leaders (intelligence, authoritarianism etc). A set of characteristics was determined which was supposedly held by all effective leaders. It was thought that, if those traits that differentiated leaders from followers could be identified, potentially successful leaders could be recognised and then placed into positions of leadership.

Many questionnaire development, trait and personality studies were dominated by this thinking earlier in the research of leadership discipline (McCrae & Costa 1989). During the 1980s the investigations of trait and personality theory of leadership were mainly derived from the theoretical Five Factor Model (FFM) of Personality or “Big Five” Model (McCrae & Costa 1989), which has been one of the more prevalent models of personality-leadership in contemporary research (Vecchio, Hearn & Southey 1996). The five factors and their associated measures are:

1. Extroversion (Reliable- sociable, quiet-talkative, inhibited-spontaneous)
2. Agreeableness (Irritable-good natured, ruthless-soft hearted, selfish-selfless)
3. Conscientiousness (Careless-careful, undependable-reliable, negligent-conscientious)
4. Neuroticism (Calm-worrying, hardy-vulnerable, secure-insecure)
5. Openness (Conventional-original, unadventurous-daring, conservative-liberal)

Findings of the numerous research projects in leadership over this period failed to find a simple pattern of traits (Vecchio et al. 1996). The research results were inconclusive and by the 1940s, researchers had changed their focus to looking at leaders’ actions rather than their individual characteristics (Vecchio et al. 1996; Gibson & Marcoulides 1995).

Definitions that focus entirely on traits and personality theory of leadership became redundant as little empirical data could be identified to support the assumptions underlying the definitions. Because this theory was tested and found to be lacking, even with ongoing ad hoc adjustments, it was abandoned. Some studies (Howell & Shamir 2005) still encompass aspects of personality such as charisma. However, the focus of leadership changed to incorporate a wider view, including aspects of the environment.

B. Behavioural Approaches

In the mid 1960s, the behavioural approach for leadership research was very popular due to the Ohio State Leadership studies (Yukl 2002; Dubrin, Dalglish & Miller 2006; Northouse 2007). The Ohio State Leadership study was one of the major pieces of research conducted over this period. This study proposed that there were two primary dimensions of leadership: consideration, and initiating structure. Initiating structure covered behaviours such as goal-orientation, structure and being directive, while consideration is described as a concern for followers, mutual trust and respect of subordinates (Vecchio et al. 1996; Gibson & Marcoulides 1995). The most appropriate leader behaviours were considered to be high initiating structure and high consideration. Unfortunately, research failed to validate these findings and this two-dimensional approach to leadership was found not to be consistently related to organisational outcomes (Gibson & Marcoulides 1995).

C. Transformational Leadership

The interaction between leaders and their direct reports became known as transformational leadership theory (Bass 2008). Transformational theory has been one of the most highly-cited leadership theories over the past two decades. In the 1970s a change in the leadership theory to transformational leadership theory became dominant, which became more consolidated in the 1980s. The transformational theory of leadership is one of the most current theories of leadership (Northouse 2007).

A prolific researcher, Burns (1978, p. 425) defined leadership as:

> "the reciprocal process of mobilising by persons with certain motives and values, various economic, political, and other resources in a context of

> competition and conflict, in order to realise goals independently or mutually held by both leaders and followers”.

In 1978, transformational leadership was first put forward by James MacGregor Burns, political scientist, who based his theory on Maslow’s hierarchy of needs to describe how a transformational leader moved followers up the hierarchy to transcend their own self-interests for the good of the organisation or group (Bass 1985; 1998; 2008). Industrial psychologist Bernard Bass (1985) operationalised the previous work from Burns’ theory of transformational leadership (1978) to develop a model of transformational and transactional leadership.

Burns’ (1978) theory of transformational and transactional leadership varied from that of Bass’s (1985) conception, as he believed that each leadership style was at either end of a continuum. However, Bass’s transformational theory emphasises two types of leadership behaviours, transactional and transformational. Transactional leadership is based around the leader swapping rewards contingent on performance whereas transformational leadership refers to the leader moving followers beyond their immediate self-interests by way of charisma, inspiration, intellectual stimulation and individualised consideration (Bass 1985). Transformational leadership is divided into two components (Bass 1985; 1998; 2008). :

1) the emotional component (inspiration and charisma) and

2) individualising and intellectualising component (intellectual stimulation and individualised consideration)

1) Emotional Component of Transformational Leadership

This consists of two elements, charisma and inspirational leadership. Charisma is an integral part of the transformational leadership theory and states that leaders are on the stage, allows deep emotional attachment with followers and is perfect for crisis situations. Charismatic leaders “engage in impressive management to bolster their image of competence, increasing subordinate compliance and faith in them” (Bass 1985, p. 40) and “have insight into the needs, values and hopes of their followers” (Bass 1985, p. 46). Bass (1985) does make a distinction between charismatic leadership and transformational leadership in that a leader can be charismatic but not transformational, but a transformational leader will be charismatic. Charisma forms the core component of transformational leadership (Waldman, Siegel & Javidan 2006).

2) Individualising and Intellectualising Component of Transformational Leadership

Individualised consideration involves leaders expressing appreciation to staff, building self-confidence and providing learning opportunities (Bass 1985). Intellectual stimulation is defined as arousal and change in the followers’ imagination and stimulation of followers’ beliefs and values.

Bass (1985) believed that most leaders display types of transformational and transactional leadership in varying degrees. Ultimately, transformational leadership augments transactional leadership. This model has been more recently referred to as the “full range leadership model” (Bass & Avolio 1997).

A fundamental difference between Bass and Burns is that Burns viewed transformational leadership as having only societal benefits, but Bass believed that it could have a societal benefit or be a cost to society (Paul et al. 2002; Bass 1985). Bass (1985) believed that transformational leaders could move followers down Maslow’s hierarchy of needs and still be transformational. Burns would have disagreed. However, Bass (1985, p. 16) argues that “in the world of work, transformational processes usually involve the upgrading of needs…Political leaders can transform the economic and technological processes, moving people from a traditional “higher level” socially orientated culture to a modern culture dominated by crass materialism.”

Criticisms of Transformational Leadership

Although there are a lot of critiques of transformational leadership, it still remains one of the most studied leadership theories (Bass 1999). Here are some of the criticisms of transformational leadership theory:

- Researchers criticised Bass (1985) suggesting that he ignored the kinds of organisation and culture in which leaders function, and the many relationships existing between leaders and superiors. But he only focused mainly on the leader and their immediate followers (House & Aditya 1997).
- Yukl (1999) argued that Bass’s theory is based on a dyadic relationship between the leader and follower instead of the effects of group dynamics. Yukl (1999) also commented on the questionable charismatic component of transformational leadership which might be more about form rather than substance.
- Pawar (2003) argued several issues surrounding transformational leadership such as the unclear distinction between charismatic leadership and transformational leadership and the need for clarity on the conceptual relationships within transformational leadership.
- Research by Lowe, Kroeck and Sivasubramaniam (1996) found that intellectual stimulation is not independent of the other three factors of transformational leadership.
- Research by Waldman et al. (2006) has found a lack of independence between individualised consideration and the other three transformational leader factors.

D. <u>Emotional Intelligence</u>

Emotional intelligence is a theory of intelligence that lends its support to enhancing leadership. It has gained a significant level of interest from corporates internationally (Yitshaki 2012). It was proposed by psychologist Daniel Goleman, who concentrates on the emotional components or the interpersonal relationships that exist within any leadership situation (Goleman 1998). Goleman (1998; 2000) and Goleman, Boyatzis and McKee (2002) put forward five components to emotional intelligence: self-awareness, self-regulation, motivation, empathy and social skill. Goleman (1998) argues that emotional intelligence is the defining element of what makes a good leader. He or she must possess communication skills, a good understanding of self and values, be democratic, highly committed, motivated and empathic. Emotional intelligence has been treated similarly to an IQ test by Goleman (1998), who has developed an Emotional Quotient (EQ) test to determine if people possess the requisite emotional characteristics of being a good leader.

Goleman (1998) describes EQ as the effectiveness of how one deals with one's own emotions and with others. There is at the moment little empirical evidence to support relating emotional intelligence to effective leadership (Palmer, Walls, Burgess & Stough 2001). Currently a lot of management training programs have included emotional intelligence as a key element of leadership training.

2.5.2 What is Leadership Capacity Framework?

Stogdill (1995) identifies the following factors associated with leadership:

- Leadership capacity through intelligence, verbal facility, originality and judgment.
- Achievement through scholarship, knowledge, or athletic accomplishments.

- Responsibility as demonstrated by dependability, initiative, persistence, aggressiveness, self-confidence and desire to excel.
- Participation demonstrated by activity, sociability, cooperation, adaptability and humour.
- Status through socio-economic characteristics, or through popularity.

From the above description, leadership capacity is considered as one of the factors or characteristics associated with leadership. This leads the investigation further to understand how important the leadership capacity is to a leader or entrepreneur in successful entrepreneurial ventures.

Street et al. (2007; 2010) developed a model which explains the relationships among first movers' organisational capacity, environmental dynamism, and performance. The environmental dynamism has the moderating role between the organisational capacity and performance effects of first moves. This model illustrates how elements of organisational capacity aid first movers in building resources leading to superior performance. "Organisational capacity" is concerned with the ability of a firm to adapt, which includes the three main dimensions of organisational capacity – combinative capabilities, leadership capacity, and slack assets. The first dimension of organisational capacity is combinative capabilities which consist of socialisation (relating to the norms and common ideology in a firm), coordination (relating to relationships and processes), and systems capabilities (concerning rules and procedures) (Van den Bosch, Volberda & de Boer 1999), and are the ability "to synthesise and apply current and acquired knowledge" (Kogut & Zander 1992, p384). The second dimension, leadership capacity, is about the general capacity of a leader to have strategic influence in the firm (Leavy 1996). Finally, five types of slack assets are identified – slack considered to be untapped or under-utilised resources that enable a firm to adapt and facilitate new strategies (e.g. Bateman & Zeithaml 1989; Cyert & March 1963). These are physical (tangible assets owned by the firm), financial (cash and equity), technological (intangible assets like quality and patents), human (assets based in the people of the firm), and reputational (attributions coming from past actions) (Weigelt & Camerer 1988) slack assets (Hofer & Schendel 1978; Grant 1991). These components of organisational capacity can be employed by first movers to create sources of resource advantages leading to superior firm performance.

The following section discusses only leadership capacity framework which is being adopted in this thesis.

Leadership Capacity Framework

Since there have not been a lot studies done on leadership capacity, the theoretical model of the first move—performance relationship from Street et al. (2010; 2011) forms the basis of understanding the leadership capacity framework. Leadership forms a central part of organisational capacity because leaders, in addition to representing the firm in the business arena, are responsible for setting organisational values and direction, and for inspiring employees to accept and work towards the mission and goals of the firm (Hinings & Greenwood 1989). Leadership capacity is concerned with a leader's experience, credibility, willingness to assume responsibility, ability to tolerate stress, and assertiveness (Street et al. 2011). Leaders should be more than just administrators or decision-makers. They can build and change an organisation (Barney & Arikan 2001; Selznick 1984). This leadership capacity is required to influence the organisation in such a manner that it is accepting of the first move and thereby incorporates it in such a manner as to create performance-enhancing resources (Street et al. 2011). The leadership capacity of a leader indicates the strategic influence that the leader can have on the firm (Leavy 1996). A firm's employees can be motivated by the influential leaders to accept something new, like a first move. The success rate of building performance-enhancing resources in the first move can be facilitated through the acceptance of employees. The capacity of a leader (Leavy 1996) to have strategic influence when a firm is making a first move may affect the first move's impact on performance.

Hinings and Greenwood (1989) focus on the concept of transformational leadership in the treatment of leadership. By virtue of their personality and ability, transformational leaders change the basic beliefs of their followers thereby motivating them to perform in ways they normally would not have performed (Kuhnert & Lewis 1987). Because Hinings and Greenwood (1989) are talking about large scale re-organisation, this type of leadership may be necessary. The incorporation of a first move into an organisation may not be as dramatic a change as that considered by Hinings and Greenwood (1989). Its ultimate success does not require the visionary, holistic abilities characteristic of a transformational leader. Rather, it is the more commonplace traits and skills (Leavy 1996) of the effective leader that afford strategic influence on the firm that will ensure that sources of advantage are created from the first move.

In general, leaders may have more of an impact in environments that are less stable and therefore less deterministic (Finkelstein & Hambrick 1996; Eisenmann & Bower 2000). If leaders can better use their leadership capacity in more dynamic environments, it is in such environmental conditions that they will be able to better facilitate the integration of first moves, thereby helping the firms see increased performance.

Implication of Leadership Capacity Framework

Leadership capacity can have the implications of improving the creativity and innovation (Antes & Schuelke 2011; DiLiello & Houghton 2006).

1. Improvement of creativity and innovation

Creative/innovative leadership capacity, which is part of leadership capacity, proves central to the success of today's organisations. It will account for which organisations remain successful into the future (Antes & Schuelke 2011). Innovation and creativity are generally considered to be critical competencies for improving organisational staying power. Effective leadership capacity will improve the creativity and innovation of any organisation.

Researchers also suggest that individual creativity is essential to organisational innovation (Amabile, 1988), which in turn is imperative to long-term organisational survival and success (Tushman & O'Reilly 1997). In order to enhance the chances of long-term survival, organisations should focus on supporting individual creativity in the workplace (Amabile 1988).

Creativity and self-leadership may be related to one another in important ways that can synergistically enhance organisational leadership capacity for the future (DiLiello & Houghton 2006). The concept of self-leadership (Neck & Houghton, 2006) suggests that an individual who engages in self-evaluation, replacing ineffective behaviours and negative thought processes with more effective behaviours and positive thought processes, can enhance personal accountability and improve professional performance. Self-leadership research also suggests that improving individual effectiveness can positively impact organisational outcomes (Manz & Neck, 2004).

As a result, organisational stakeholders must consider the nature of the developmental experiences provided to their organisational members and, in particular, their leaders. Opportunities to develop and hone the knowledge and skills necessary for effective creative/innovative leadership must be provided to set an organisation’s people (and thus the organisation) apart from others. By leveraging technology these creative/innovative leadership capacities can be acquired very easily (Antes & Schuelke 2011).

2.5.3 What is Entrepreneurial Leadership?

Since entrepreneurial leadership has been identified as the most crucial factor in the management of high growth ventures which will add the competitive edge, many researchers have investigated the significance of entrepreneurial leadership in organisations (Oliver & Paul-Shaheen 1997; van Zyl & Mathur-Helm 2007; Darling, Keeffe & Ross 2007).

Other than leadership skills, entrepreneurial leaders need to use the following to lead the organisation: vision (Ruvio, Rosenblatt & Hertz-Lazarowitz 2010), culture creation (Ireland, Hitt & Sirmon 2003), entrepreneurial team building (Montes, Moreno & Morales 2005; O'Connor & Yballe 2007; Ensley, Pearce & Hmieleski 2006; Schaubroeck, Lam & Cha 2007). Many research studies have explored the impact of these elements on the organisation (Bencsik & Bognár 2007; Floyd & Woolridge 1999; Garcia-Morales, Llorens-Montes & Verdu-Jover 2006; Senker 1996; Chataway, Tait & Wield 2004). Moreover, extensive literature has also demonstrated that leadership plays an important role in improving company performance by involving these elements in the defined scope (Hemlin 2006; García-Morales, Lloréns-Montes & Verdú-Jover 2008; Schneider 2002; Ensley, Hmieleski & Pearce 2006; Tarabishy, Solomon, Fernald Jr. & Sashkin 2005). Some of the elements are interrelated.

(1) Vision

Leaders ought to have vision which can be shared as a dream or direction for their people to understand, embrace and follow. Vision plays a critical role in guiding and motivating the leader. If organisational leaders have no vision, they are doomed to work under the burden of mere tradition and cannot prosper for the growth of the organisation (Sosik & Dinger 2007). Vision also guides the entrepreneur through the long journey of venture creation process (Baum & Locke 2004; Ensley, Carland & Carland 2000). Vision has a crucial position in the entrepreneurial process and is also included in the definition of entrepreneurial leadership (Gupta et al. 2004; Hitt, Ireland & Hoskisson 2001). At the initial stage of entrepreneurial process, vision is visualised as a mental image representing the picture of the future venture and the signposts along the way to reaching the goal. An entrepreneur who has entrepreneurial vision together with the appropriate leadership skill, behaviour and style should have the drive to keep on pursuing venture creation. Besides motivating the entrepreneur, a clear vision statement can powerfully communicate both the purpose and values of the start-up company and motivate the entrepreneurial team or organisation to realise an inspiring and achievable common vision of the future (Ruvio, Rosenblatt & Hertz-Lazarowitz 2010). The entrepreneurial vision can go beyond just the written organisational vision statement (Sosik & Dinger 2007). The vision of entrepreneurial leadership permeates the business strategy and the start-up company. It is also manifested in the entrepreneurial leader’s actions, beliefs, values and goals.

(2) Culture creation

Organisational culture consists of a system of beliefs and shared values held by its members which distinguish the organisation from others. It establishes the firm’s structural arrangements and affects the action of its members in producing behavioural norms. Entrepreneurial culture is described as the organisational culture which facilitates and accommodates the entrepreneurial activities of the firm in the marketplace (Dimitratos & Plakoyiannaki 2003). Effective entrepreneurial culture involves expectation of new ideas and creativity from staff, encouragement for risk taking, toleration of failure, championing product, process and administrative innovations and continuous change for opportunities (McGrath & MacMillan 2000). In order to promote entrepreneurship through the organisation, entrepreneurial culture has to be established and followed through by top management. They have to demonstrate how to embrace the entrepreneurial culture by their behaviour and action so that this culture can filter through the organisation. In fact, the entrepreneurial leaders who act as champions can create and nurture the entrepreneurial culture of the organisation (Ireland, Hitt & Sirmon 2003). Without committed opportunity-seeking and advantage-seeking leadership behaviour in the entrepreneurial culture, the presence of entrepreneurial opportunity existing in uncertain business environments may not be recognised and exploited successfully for sustainable competitive advantages.

(3) Entrepreneurial team building

Teams, which are the basic organising structure for accomplishing work in many firms, have emerged as an essential feature of the successful organisational landscape in dynamic and complex environments (O'Connor & Yballe 2007). Team building is a way to motivate the team by encouraging individuals to participate together in activities. In team building, the most enthusiastic staff members will retain their enthusiasm, while unenthusiastic staff members will be motivated to have opportunities to change their approach to team work (Toofany 2007). If team building strategies are being implemented appropriately, they can help the organisation to improve its venture performance (Schaubroeck, Lam &

Cha 2007). Team leadership can generally be defined as the influencing of the attitudes and behaviours of individuals and the interaction within and between groups for the purpose of achieving goals for the team (Bass 2008). Valuing the unique contributions of all team members, entrepreneurs can concentrate on the team building processes by showing the appropriate entrepreneurial leadership behaviour through various stages of venture growth. Consequently, more entrepreneurial teams under the influence of entrepreneurial leadership will be formed with wide-ranging experiences and knowledge enabling them to achieve better venture performance as advanced technology changes the speed and efficiency of business in the environmental dynamism (Ensley, Pearce & Hmieleski 2006).

2.5.4 Intersection of Entrepreneurship and Leadership

Entrepreneurial leadership refers to the intersection of the characteristics of the "entrepreneurship" and "leadership" concepts. Various definitions have been given to entrepreneurship leadership in research. Ireland and Hitt (1999) describe it as the influencing process of an individual on others for strategic resource management both in opportunity-seeking and advantage-seeking behaviours. Swiercz and Lydon (2002) refer to entrepreneurial leaders as individuals with the ability to initiate, develop and manage entrepreneurial organisations. Gupta et al. (2004) define entrepreneurial leadership as leadership having the creation of visionary scenarios for the assembly and mobilisation of a "supporting cast" of participants who have commitment to the vision for the discovery and exploitation of opportunity for strategic value creation. Morris, Schindehutte and LaForge (2004) propose that

> “successful entrepreneurial leadership can generally be thought of as leading, through direct involvement, a process that creates value for organisational stakeholders by bringing together a unique innovation and package of resources to respond to a recognised opportunity. In fulfilling this process, entrepreneurs function within a paradigm of three dimensions: innovativeness, risk-taking, and proactiveness”.

In this thesis, the definition of entrepreneurial leadership proposed by Hitt, Ireland and Hoskisson (2001) is being adopted as “the entrepreneur’s ability to anticipate, envision, maintain flexibility, think strategically, and work with others to initiate changes that will create a viable future for the organisation”. In summary, based on the above views, entrepreneurial leaders may have the ability to explore their environments, discover and identify opportunities that could be exploited while they show leadership skills in motivating others to actively participate in this process towards value creation.

Leadership style is about “the combination of traits, skills, and behaviours leaders use as they interact with followers” (Lussier & Achua 2007). Dubrin, Dalglish and Miller (2006) suggest that entrepreneurial leadership style will include the characteristics of: strong achievement drive and sensible risk taking; a high degree of enthusiasm and creativity; a tendency to act quickly when opportunity appears; constant hurry combined with impatience; a visionary perspective; a dislike for both hierarchy and bureaucracy; a preference for dealing with external customers; and an eye on the future.

In summary, entrepreneurial leaders who are generally task-oriented, charismatic, have relentless drive and are inspirational to others, are also likely have the ability to create and articulate a clear vision for an organisation, explore their environment, identify opportunities that could be exploited while they show the leadership skills in motivating others with the built trust to actively participate in the entrepreneurial process towards value creation in high-technology industry. Entrepreneurial leadership will permeate the strategies of the company which becomes the source of competitive advantage in the dynamic business world.

2.5.5 Leadership skills, behaviour and styles

Appropriate leadership skill, behaviour and style are quite important for entrepreneurs in the process of venture growth. Table 2.17 lists the associated entrepreneurial traits, tasks, leadership skills, behaviours, styles in the various stages of the entrepreneurial process (Antonakis & Autio 2007). Leadership skill is described as “the ability to use one’s knowledge and competencies to accomplish a set of goals and objectives” (Northouse 2007). Effective leadership needs to have one or more of these three basic personal skills depending on the management level: technical (knowledge about and proficiency in a specific type of work or activity); human (knowledge about and ability to work with people); and conceptual (ability to work with ideas and concept). Technical and human skills are most important for lower management, while upper management levels need the conceptual and human skills. However, all three leadership skills will be required for middle managers (Northouse 2007). Moreover, more specific management skills have been described which encompass the leadership skills: personal skills (e.g. self-awareness; managing stress; analytical and creative problem solving); interpersonal skills (e.g. coaching and supportive communication; gaining power and influence; motivating others; managing conflict); group skills (e.g. empowering and delegating; teamwork and leading positive change) (Whetten & Cameron 2005).

Leadership behaviour involves the skills of both using and responding to emotion, for example, body language, physical activity, communication (through writing, speaking and active listening) and personal power (Gill 2006). Effective leadership behaviour, which may involve the exercise of authority, is characterised by the ability of the leader to influence the activities of a group. By using goal-setting in the initiating structures it enables the group to successfully overcome mutual problems and to achieve its group goals.

Table 2.17 Associated entrepreneurial traits, tasks and leadership skills/behaviours/styles in various stages of entrepreneurial process (Adapted from Antonakis and Autio 2007)

Entrepreneurial Process Stage	Entrepreneurial Traits	Entrepreneurial Tasks		Leadership Skills	Leadership Behaviours/Styles
Pre-launch & Launch (Early Stage)	-Openness to experience -Conscientiousness (achievement motivation) -General intelligence -Self-efficacy -Locus of control	Internal -Opportunity evaluation -Planning -Team building	External -Opportunity recognition -Resource identification -Resource access	Self-awareness Managing stress Analytical & creative problem solving	Leadership of External Constituents **Transactional** -deal making: contingent rewards and sanctions **Transformational/Entrepreneurial** -intellectual stimulation -idealised influencing -inspirational motivation
Start-up (Commercialisation/ Operational/ Expansion)	-Conscientiousness (achievement motivation) -General intelligence -Self-efficacy -Locus of control -Extraversion -Risk taking	-Planning -Motivation -Team building -Resource building	-Resource access -Resource mobilisation -Legitimisation	Self-awareness Managing stress Analytical & creative problem solving Coaching and supportive communication Gaining power and influence Motivating others Managing conflict Empowering and delegating Teamwork Leading positive change	Leadership in Instrumental -strategy formulation -strategy implementation **Transactional** -contingent rewards and sanctions **Transformational/Entrepreneurial** -intellectual stimulus -idealised influence -inspirational motivation -individualised consideration
Consolidation (Exit)	-Need for power greater than achievement motivation - Need for power greater than need for affiliation -General intelligence -Self-efficacy -Locus of control -Extraversion	-Planning -Motivation -Coordination -Delegation	-Resource consolidation -Environmental monitoring -Competitive response	Self-awareness Managing stress Analytical & creative problem solving Gaining power and influence Leading positive change	Leadership of Distant Leadership **Instrumental** -environmental monitoring -strategy implementation **Transformational/Entrepreneurial** -idealised influence -symbolic communication -vision communication

Gupta et al. (2004) suggest that the ability to extract exceptional commitment and effort from organisational stakeholders by convincing them that not only can they accomplish goals but that their efforts will lead to extraordinary outcomes; the ability to articulate a compelling organisational vision and perseverance in the face of environmental change are important features of entrepreneurial leadership.

Although there are many leadership styles, there is no one best or most effective leadership style that will be appropriate for all kinds of situations. It is important to select the best leadership style with a degree of versatility and flexibility which enable the entrepreneurs to adapt their behaviour to the changing and contradictory demand (Bass 2008).

Transformational leadership is described as "a style of leadership that transforms followers by stimulating them to go beyond self-interest through altering their morale, values and ideals, and motivating them to perform above expectations" (Bass 2008). Moreover, entrepreneurial leadership can be defined as "leadership that creates visionary scenarios used to assemble and mobilise a 'supporting cast' of participants who become committed by the vision to the discovery and exploitation of strategic value creation" (Gupta, MacMillan & Surie 2004). Since both terms for transformational and entrepreneurial leadership are very similar in nature, this suggests that either may provide competitive advantages in improving organisational performance (Darling, Keeffe & Ross 2007). In the proposed new model, a number of features of transformational leadership are incorporated. In Table 2.17**,** appropriate leadership behaviours or styles for the various stages of the entrepreneurial process have been suggested.

Entrepreneurial leadership shares a number of common features with transformational leadership. Transformational leadership involves the improvement of the performance of followers and development of followers to their fullest potential through inspirations (Ensley, Hmieleski & Pearce 2006) and shares a common goal and vision for the team. Further communicating a compelling vision, which is related to a shared vision among followers, is seen as an important part of transformational leadership (Schippers, Den Hartog, Koopman & van Knippenberg 2008). Rather than just encouraging followers to accept articulated ambitious collective goals, transformational leaders support them in working toward goals, by acting as a role model, stimulating them to engage in analysis, showing concern for them as individuals, and encouraging teamwork (Newman 2006).

Based on the above views, it can be concluded that entrepreneurial leaders who are generally task-oriented, charismatic, have relentless drive and are inspirational to others, are also likely to have the ability to create and articulate a clear vision for an organisation, explore their environment, identify opportunities that could be exploited while they show the leadership skills in motivating others with the built trust to actively participate in the entrepreneurial process towards value creation in high-technology industry.

In summary, entrepreneurial leaders who have acquired the appropriate leadership skill, behaviour and style may have the ability to explore their environments, discover and identify opportunities that could be exploited while they show leadership skills in motivating others to actively participate in this process towards value creation. Entrepreneurial leadership with the appropriate leadership skill, behaviour and style will permeate the strategies of the company which becomes the source of competitive advantage in the dynamic business world.

2.5.6 The Significance of Entrepreneurial Leadership Capacity to Entrepreneurial Biotechnology Industry

If the Entrepreneurship Policy Matrix Model in Table 2.15 is applied to the biotechnology industry (Hindle & Rushworth 2002), what is the most important impact that individual bioentrepreneurs can provide to the biotechnology industry in general? The answer is "leadership" from the Matrix Model. How important is leadership in the biotechnology industry? How can we make biotechnology industry more entrepreneurial? The answer is with the "entrepreneurial leadership". With the significance of entrepreneurial leadership skills applied by the bioentrepreneurs, the biotechnology industry will become more entrepreneurial with innovative ideas and products in leading the competition.

Since there are many definitions of leadership, I have adopted the general meaning of leadership as "a process whereby an individual influences a group of individuals to achieve a common goal" (Northouse 2007). However, Lussier and Achua (2007) refine this generalised definition in the context of organisational behaviour as "leadership is the influencing process of leaders and followers to achieve organisational objectives through change". Some may consider leadership is more than an art. It can be a form of performing art.

According to the highly-regarded Excellence Model promoted by the European Foundation for Quality Management (EFQM) and the British Quality Foundation (BQF), the leaders and leadership can be described as the following (EFQM 2000) :

- Leaders develop the mission, vision and values and are role models of a culture of excellence
- Leaders are personally involved in ensuring the organisation's management system is developed, implemented and continuously improved
- Leaders are involved with customers, partners and representatives of society
- Leaders motivate, support and recognise the organisation's people

- Leadership can stimulate and encourage empowerment, innovation and creativity
- Leadership aligns organisational structure to support delivery of policy and strategy
- Leadership supports and engages in activities that aim to improve the environment and the organisation's contribution to society
- Leadership can communicate the organisation's mission, vision, values, policy and strategy, plans, objectives and targets to people.

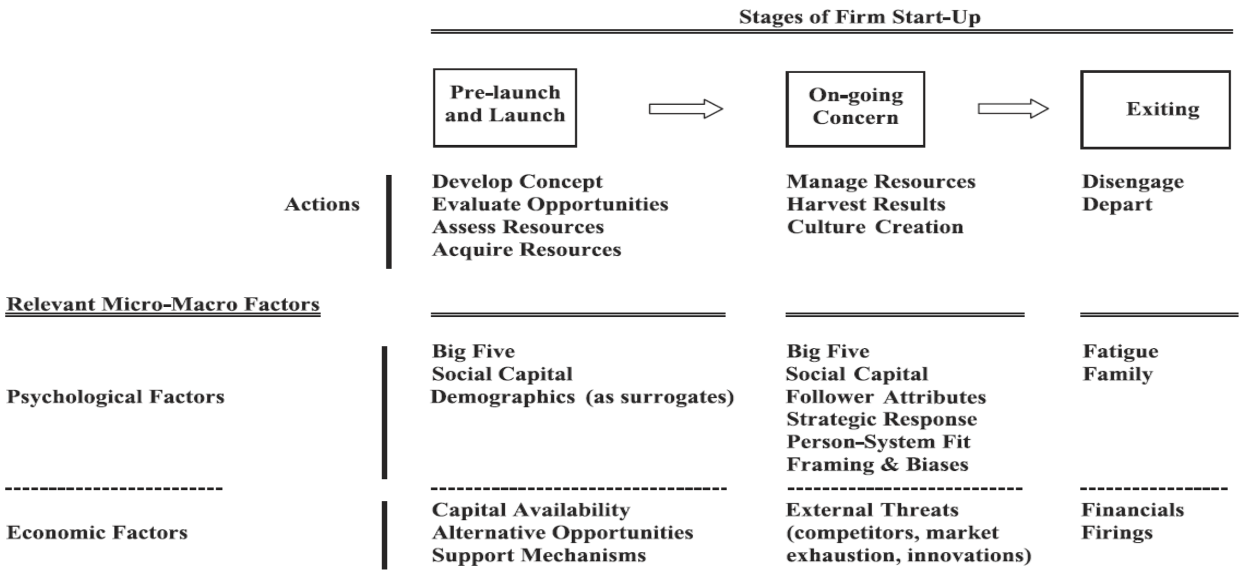
The general public will think that management and leadership are the same discipline. Bass (1985) points out very clearly that "Management is not only leadership, nor is leadership only management; however, those appointed to a position of responsibility as managers need to appreciate what leadership is expected of them". If the managers are carrying out their leadership responsibility, this managerial leadership can convert competent administrators into effective managers.

Dalglish and Evans (2000) argue the intrinsic essence of leadership skills to the entrepreneurial success. Like entrepreneurial skills, leadership skills can be taught to entrepreneurs for achieving a higher degree of success. Actually, there are many common personal characteristics between entrepreneurs and leaders, such as adaptability, persistence, achievement orientation and high level of energy (Dalglish & Evans 2000). In the context of entrepreneurship, this "leadership" can be called "entrepreneurial leadership'"'. This leads Kuratko and Hornsby (1998) to describe "entrepreneurial leadership" as the emerging critical factor for the twenty-first century corporation.

Vecchio (2003) has proposed a more comprehensive model (Figure 2.8) of entrepreneurial leadership that incorporates both entrepreneurial process and context in differentiating effectiveness in entrepreneurial behaviour such as launching, managing, and exiting a new firm.

> "This model suggests that the process of firm start-up must recognise at least three phases: pre-launch and launch, the ongoing concern, and exiting…Beyond merely laying out or describing these stages, the model proposes that certain psychological factors may be more critical at some stages than others. Further, certain economic factors may be of greater importance at specific stages as well. Prior efforts to relate psychological factors to entrepreneurship have failed to consider that factors may vary in importance according to the stage of a firm's existence. In addition to ignoring process issues, prior psychological research has ignored the role of broader contextual or economic factors."

Figure 2.8 A model of entrepreneurial leadership that integrates process and level influences



Source: Vecchio (2003)

Vecchio's (2003) model of entrepreneurial leadership has been adopted and modified as the driving forces between the entrepreneur and the entrepreneurial process for life cycle of venture growth in this proposed model of entrepreneurship in high-technology industry like the biotechnology industry.

2.6 What is Biotechnology?

The term ‘biotechnology’ is very broad. Generally, it encompasses technologies based on the application of biological processes and has found diverse application in medicine, agriculture, food processing, manufacturing and environmental management. The field of biotechnology is not new. Frequently the term “modern biotechnology” is used to distinguish recent, research-based genetic engineering activities from earlier biotechnology, which included the traditional fermentation technologies, such as bread, cheese and beer-making, and traditional animal and plant breeding. These more traditional technologies have been around for a long time. For example, yeasts have been used to brew beer and make wine as long ago as 6000BC, while bread, made with yeast, and cheese, made with bacteria, have been common for centuries. However, the development of modern biotechnology has been driven largely by scientific research initiatives. The modern biotechnology can be interpreted as the masterpiece of the combination of biology, computer science, chemistry, physics and engineering in which each component technology works in synergy (Rowley 2002).

Biotechnology can offer the solution to improve both the efficiency and sustainability of primary production, including crops, livestock, timber and aquatic production and processing. The tools of biotechnology can be employed to develop higher yielding and more nutritious crops and livestock, improve resistance to disease and adverse conditions, increase the quality of food, and to reduce the use of fertilisers and pesticides harmful to the environment. Based on all these benefits biotechnology is recognised as the catalyst for economic development which can bring a lot of business growth.

In addition to its significant advancement as a key technology in creating new products and processes, biotechnology has emerged as an important accelerator for economic development in this century due to its potential for the increase of productivity in existing industries, job creation and the stimulated demand for skilful workforces (Menrad 2000). To the extent that future economic well-being may depend on these emerging biotechnology companies, **e**ntrepreneurship or bioentrepreneurship is considered as the driving force in linking creativity and innovative discoveries for the outcome of improving the economy and creating wealth and jobs. The traditional entrepreneurial model has been suggested *as appropriate* to evaluate life science ventures such as biotechnology. However, based on interviews of founders of biotechnology firms, Mehta (2004) has confirmed that there are alternative paths to biotechnology venture growth which are different from typical entrepreneurial ventures.

Pisano (2006a) also points out in his extensive analysis that bioentrepreneurship is not the same as the typical industrial or high-tech entrepreneurship.

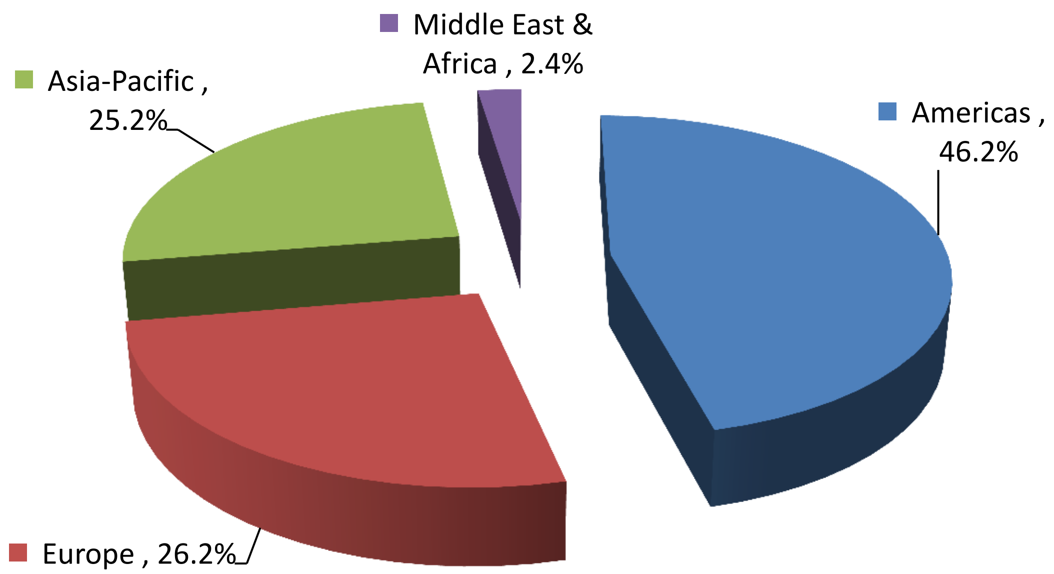
> "The anatomy of the biotechnology sector – much of it borrowed from models that worked quite well in software, computers, semiconductors, and similar industries – is fundamentally flawed, and therefore cannot serve the needs of both basic science and business. Unless that anatomy changes dramatically, biotechnology will not be able to attract the investments and talent required to realise its potential for transforming health care…Businesses engaged in advancing basic science as a core activity need a new design" (Pisano 2006a).

2.6.1 Overview of Global Biotechnology Industry

Generally, the biotechnology industry is seen as one of the most globalised. It is also an industry dominated by small and medium enterprise (SMEs) in most countries. These biotechnology SMEs themselves are expected to be global in their focus too.

Figure 2.9 (Datamonitor 2011h) lists the market shares of various regions for global biotechnology industry in 2010. The global biotechnology market has experienced strong growth over the past few years. There was strong growth in 2010 and the market is expected to continue growing towards 2015. Americas accounts for 46.2% of the global biotechnology market value while Europe accounts for a further 26.2% of the global market. The APAC region, which accounts for 25.2% of the global market, includes Australia in this category. From the Datamonitor resource database, no Australian biotechnology industry data can be obtained.

Figure 2.9 Market shares of various regions for global biotechnology industry in 2010



Source: Datamonitor (2011h)

Table 2.18 (Datamonitor 2011a-n) displays the market value and growth percentage in various regions and countries for global biotechnology industry (2006 - 2010) which includes the APAC region, Europe, USA, UK, Japan, Germany and China etc. The global biotechnology market had total revenue of $250 billion in 2010, representing a compound annual growth rate (CAGR) of 10.8% between 2006 and 2010. In comparison, the European and Asia-Pacific markets grew with CAGRs of 10.7% and 11.6% respectively, over the same period, to reach respective values of $65.5 billion and $63.1 billion in 2010.

Table 2.18 Market value and growth percentage in various regions and countries for biotechnology industry (2006 - 2010)

	Global		APAC		Europe		USA		UK		Japan		Germany		China	
	billion (US$)	Growth (%)	billion (US$)	Growth (%)	billion (US$)	Growth (%)	billion (US$)	Growth (%)	billion (US$)	Growth (%)	billion (US$)	Growth (%)	billion (US$)	Growth (%)	billion (US$)	Growth (%)
2006	166.1	21.8	40.7	25.2	43.6	21.4	58.3	12.2	6.1	7.0	23.8	15.0	4.3	0.0	4.5	21.9
2007	185.8	11.9	45.9	12.8	47.9	10.0	64.9	11.3	6.6	7.8	26.3	10.6	5.4	24.2	5.6	24.9
2008	209.4	12.7	55.8	21.5	52.5	9.5	70.1	8	6.5	(2.2)	33.9	28.7	5.7	6.6	6.7	20.6
2009	231.2	10.4	59.6	6.8	61.5	17.3	77.1	10.0	6.2	(4.4)	36.0	6.3	6.1	6.2	7.7	14.2
2010	250.0	8.1	63.1	5.9	65.5	6.5	84.8	10.0	7.0	14.0	36.3	0.7	4.5	(26.0)	8.8	14.2
CAGR (2006-2010)		10.8%		11.6%		10.7%		9.8%		3.6		11.1%		1.0%		18.4%

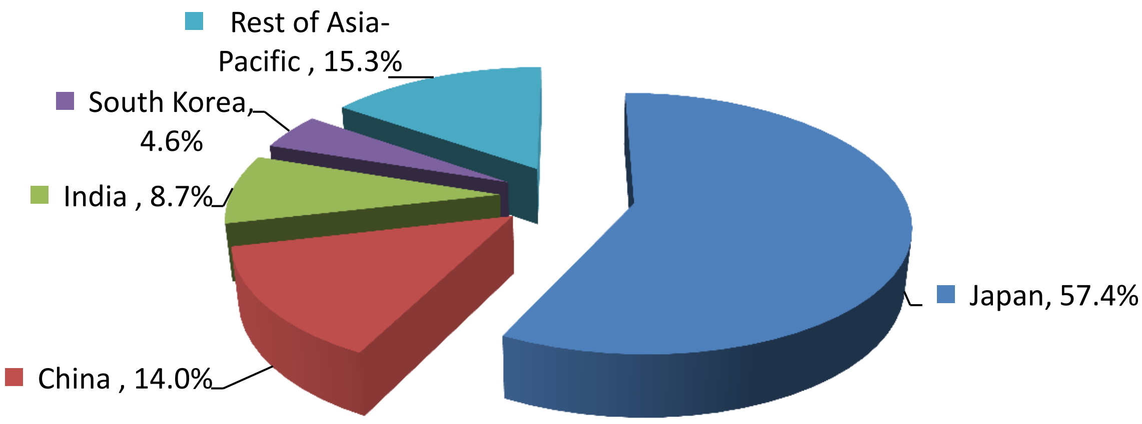
Note: 2005 data are not provided but the growth rate (%) is calculated with 2006 data.

The formula for Compound Annual Growth Rate (CAGR) calculation is as follows (Investopedia 2011): $\mathrm{CAGR} = \left(\frac{\text{Ending Value}}{\text{Beginning Value}}\right)^{\left(\frac{1}{\#\text{ of years}}\right)} - 1$

Source: Adapted from Datamonitor (2011a-n)

Figure 2.10 (Datamonitor 2011a) shows the market shares of various countries for the APAC biotechnology industry in 2010. Japan accounts for 57.4% of the Asia-Pacific biotechnology market value. China accounts for a further 14% of the Asia-Pacific market. The Asia-Pacific biotechnology market had total revenue of $63.1 billion in 2010, representing a compound annual growth rate (CAGR) of 11.6% between 2006 and 2010 (Table 2.18).

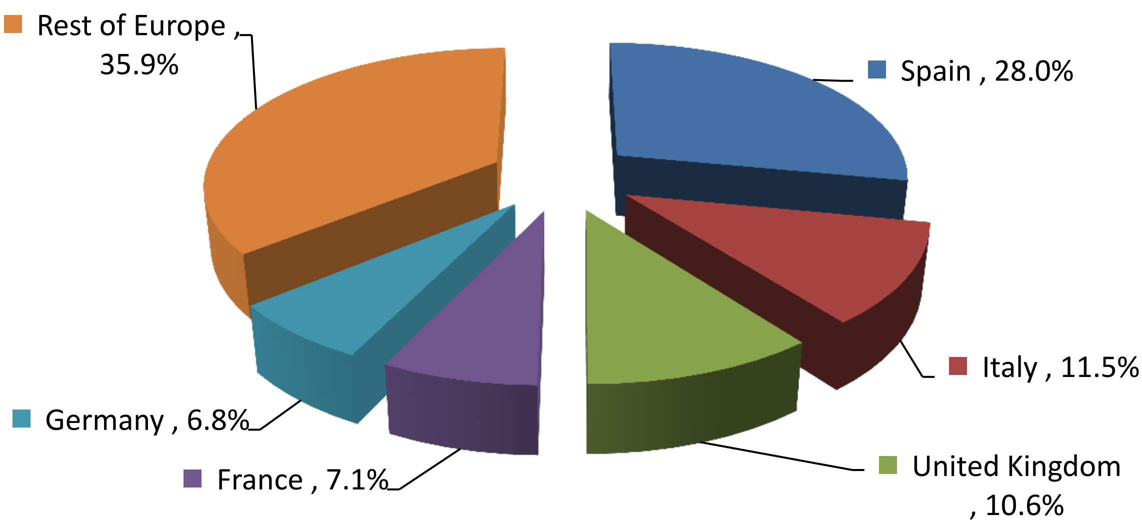
Figure 2.10 Market shares of various countries for APAC biotechnology industry in 2010



Source: Datamonitor (2011a)

Figure 2.11 (Datamonitor 2011e) displays the market shares of various countries for Europe biotechnology industry in 2010. The European biotechnology market had total revenue of $65.5 billion in 2010, representing a compound annual growth rate (CAGR) of 10.7% between 2006 and 2010 (Table 2.18). In comparison, the German and UK markets grew with CAGRs of 1% and 3.6% respectively, over the same period, to reach respective values of $4.5 billion and $7 billion in 2010 (Table 2.18).

Figure 2.11 Market shares of various countries for Europe biotechnology industry in 2010



Source: Datamonitor (2011e)

Table 2.19 (Datamonitor 2011a-n) demonstrates the market segmentation by technology sectors in various regions for biotechnology industry in 2010. The market segments are medical/healthcare, service provider, food & agriculture, technology service, and environmental & industrial processing. The actual revenue figures involved with those segments can be found in more detail in those related report in Datamonitor databases. Table 2.19 only lists the percentage of that segment to the overall segments without the actual revenue figures.

Table 2.19 Market segmentation by technology sectors in various regions for biotechnology industry in 2010

	Global	APAC	Europe	USA	UK	Japan	Germany	China	Spain	Italy	Canada	Belgium	France	Netherlands
Market segments Medical/ Healthcare	67.1%	55.2%	78.2%	67.3%	69.1%	42.4%	70.3%	92.4%	76.6%	93.6%	68.5%	77.5%	82.0%	76.9%
Service provider	14.1%	2.3%	8.8%	24.5%	17.2%	3.2%	13.7%	0.3%	9.1%	1.4%	1.4%	1.7%	10.2%	8.5%
Food & agriculture	10.6%	23.0%	8.7%	4.2%	11.4%	25.2%	6.5%	5.9%	9.3%	4.1%	24.3%	15.6%	3.9%	9.9%
Technology service	4.4%	8.8%	1.3%	3.9%	1.0%	12.4%	3.5%	1.1%	1.5%	0.3%	0.2%	0.2%	1.9%	1.7%
Environment & industrial processing	3.7%	10.7%	3.0%	0.1%	1.2%	16.8%	6.0%	0.4%	3.5%	0.6%	5.6%	5.0%	2.1%	3.0%
	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%	100%

Source: Adapted from Datamonitor (2011a-n)

In the global biotechnology market in 2010, medical/healthcare sales proved to be the most lucrative segment with total revenues of $167.7 billion, equivalent to 67.1% of the market's overall value. In comparison, sales of service provider generated revenues of $35.3 billion in 2010, equating to 14.1% of the market's aggregate revenues (Table 2.19).

In the APAC biotechnology market in 2010, medical/healthcare sales proved to be the most lucrative segment with total revenues of $34.9 billion, equivalent to 55.2% of the market's overall value (Table 2.19).

In the European biotechnology market in 2010, the medical/healthcare sales proved to be the most lucrative segment with total revenues of $51.3 billion, equivalent to 78.2% of the market's overall value. In comparison, sales of service provider generated revenues of $5.8 billion in 2010, equating to 8.8% of the market's aggregate revenues (Table 2.19).

Other than the Datamonitor databases for global biotechnology industry statistics, Ernst & Young's "Beyond Borders: Global Biotechnology Report" is also a good and reliable source for industry data (Ernst &Young 2012). The following section provides another overview of the global biotechnology industry for USA, Europe, Canada and Australia, shown in Table 2.20. As always, since the US accounts for a large majority of the industry's revenues, the US story is very similar to the global one. The revenues of US publicly-traded biotechnology companies declined in 2011 (Ernst &Young 2012). R&D increased by 9%, after having declined sharply in 2009 and increasing by a modest 3% in 2010. The industry's net income position weakened for the three megadeals mentioned above. The number of companies held steady and employees grew by 5%— identical to the increase in headcount in 2010.

Table 2.20 Financial performance of biotechnology sector for Australia, USA, Canada and Europe between 2010 and 2011

Public company	Australia			USA (US$b)			Canada			Europe		
	2011	2010	% change	2011	2010	% change	2011	2010	% change	2011	2010	% change
Revenues (US$m)	4172	4465	6%	58.8$b	61.1$b	-4%	998	1271	-21%	18911	17233	10%
R&D expense (US$m)	583	517	13%	17.2$b	17.2$b	0%	431	449	-4%	4921	4513	9%
Net income (US$m)	822	717	15%	3.3$b	5.2$b	-36%	(344)	(358)	-4%	(0.3)	(568)	-100%
Market capitalisation (US$m)	22411	25626	-13%	278$b	292$b	-5%	4042	4714	-14%	71519	78639	-9%
Number of employees	13140	12760	3%	98560$b	113010$b	-13%	3600	4880	-26%	48330	46450	4%
Number of public companies	61	67	-9%	318	320	-1%	71	72	-1%	167	170	-2%
Number of private companies	N/A	N/A	N/A	1552	1594	-3%	146	153	-5%	1716	1758	-2%
Number of public & private companies	N/A	N/A	N/A	1870	1914	-2%	217	225	-4%	1883	1928	-2%

Note: The unit for the USA financial performance is in US$ billion while the rest is in US $ million. Source: Adapted from Ernst &Young (2012)

In Europe, as in the US, publicly-traded biotechnology companies increased their top lines by 10%, compared to 12% in 2010 and 8% in 2009. R&D expense, which had declined by 2% in 2009 and increased modestly by 5% in 2010, grew by a much more robust 9% in 2011. A significant difference from the US performance, however, was on the bottom line. While US companies' net profit decreased in 2011, European companies went in the other direction, essentially bringing the industry to the brink of aggregate profitability for the first time in its history (Ernst &Young 2012).

. However, despite this significant increase in financing over 2010, the sector is still below financing levels of 2005, 2006 and 2007 (Ernst &Young 2012).

The performance of Australian publicly-traded biotechnology companies showed robust improvement in 2011. Revenues grew by 6%, R&D expenses by 13% and the collective bottom line improved by 15% relative to 2010. As always, these results are strongly affected by CSL, the colossus of Australia's biotechnology sector, which continued to post healthy product sales and revenue growth. In addition, the 2011 numbers were affected by transaction-related events at a couple of other Australian firms (Ernst &Young 2012).

2.7 Australian Biotechnology Industry

The purpose for this section is to provide a brief summary of the evolution of the Australian biotechnology industry. It is not intended to provide a comprehensive overview. Sources used to compile industry tables and charts for the Australian biotechnology industry in this chapter may not be consistent due to different classification for the industry segments etc.

Historically, the comparative advantage of Australia has been mainly relying on its huge resources of minerals and agricultural land. Economic development has relied heavily on the exploitation of natural resources, areas that traditionally have a low innovation intensity measured in terms of R&D expenditure relative to turnover (DISR 2000). Australia has a relatively small manufacturing sector in which many firms are small- and medium-sized enterprises that have insufficient resources for research and development. Australian firms realise the importance of basic research and the use of portfolio approach in corporate R&D management. However, research work in Australian firms tends to focus on applied research with only a limited involvement in medium- and long-term research.

The present industrial R&D in Australia is characterised by low private R&D expenditure and difficulties in commercialisation of R&D (McFarlane 1999). The ratio of R&D spending by companies to GDP remained 0.52% to 0.87% in the first half of the 1990s, which is much lower than the ratios of major OECD countries. Although the introduction of the 150% tax concession for R&D expenditure in 1985 has played a positive role in promoting industrial R&D (125% since 1996), R&D conducted by private industries is relatively limited. Over 60% of research in Australia is funded by the government rather than by business. Most government funding is allocated to public research institutions such as the Commonwealth Scientific and Industrial Research Organisation (CSIRO) and universities in which research projects tend to focus on fundamental research instead of product development driven by market need. Hence, market forces have had relatively little influence over the direction of R&D in Australia, and the commercialisation of R&D has historically been neglected (Liao & Greenfield 1998). In particular, Australia has limited R&D investments in strategically important manufacturing sectors, such as machinery and transport equipment. In addition, the country has not been very successful in commercialising R&D including the structural and historical characteristics of Australian industry, capital availability, and coordination between the public research sector and industry. The perception of

Australia's economic performance in the context of the knowledge economy is that Australia is too heavily reliant on its traditional "old economy" industries.

A weak degree of private investment, and a history of protection from international market forces, are the characteristics for the investment in Australia's Science, Engineering and Technology (SET) base. Since Australia's national system of innovation is delicate, it has a high degree of dependence on R&D-intensive industry by overseas firms and few large innovative manufacturing firms. The export profile of Australia is still heavily dependent on traditional commodities (DISR 2000). However, Australia's traditional SET base has provided a foundation to take up a strong position in the "new" economy.

Although the Australian biotechnology industry is considered to be very small in size by international standards, it is still in a growth phase (Biotechnology of Australia 2000). It also has a growing number of excellent biotechnology companies dedicated to taking this science to the commercialisation endpoint for economic growth. Individually, Australian biotechnology companies are striving as hard for creativity and competency as their international competitors.

To strengthen Australia's competitiveness in biotechnology, Biotechnology Australia was set up in 1999 as a national agency for the coordination of government interests in biotechnology, with the coverage of issues from industry, agriculture, health, environment, education and science. Furthermore, a National Biotechnology Strategy was established in 2000 by the government (Biotechnology of Australia 2000) as the national approach with the mission of providing a blueprint for capturing the benefits of biotechnology for Australia. As the consequence of the government's Innovation Statement, *Backing Australia's Ability* (Commonwealth of Australia 2001a) the Biotechnology Centre of Excellence was announced in January 2001 with the allocation of $46.5 million over five year. The Centre has the following vision (Commonwealth of Australia 2001b).

> "To help Australia become an international biotechnology centre of excellence."

Backing Australia's Ability has supported the National Biotechnology Strategy financially through additional funding for the Biotechnology Innovation Fund (BIF) and funding for the establishment of the National Stem Cell Centre as the Biotechnology Centre of Excellence. A recent review of the Biotechnology Innovation Fund supporting 160 projects, indicated that it is highly successful in assisting Australian start-up biotechnology companies to conduct their research. The new National Stem Cell Centre builds on Australia's research excellence, increasing its international competitiveness.

To further encourage Australia's research and business communities for strengthening its competitiveness in biotechnology, the Australian Government will provide funding of $20 million to continue the National Biotechnology Strategy and Biotechnology Australia over the next four years as the campaign for *Backing Australia's Ability-Building Our Future through Science and Innovation* (Commonwealth of Australia 2004b). This extra funding commenced in July 2004.

Further information for the development of the Australian biotechnology industry can be referred to these two government reports, *Powering ideas: An innovation agenda for the 21st century* (Commonwealth of Australian 2009) and *Australian Innovation System Report 2011* (Commonwealth of Australian 2011).

2.7.1 Industry Overview

AustBiotech, the Australian biotechnology industry organisation representing a broad range of traditional and entrepreneurial biosciences.is dedicated to "the development, growth and prosperity of the Australian biotechnology industry, by providing initiatives to drive sustainability and growth, outreach and access to markets, and representation and support for members nationally and around the world" (AusBiotech 204a). The breakdown of Australian biotechnology sectors is shown in Table 2.21 (AusBiotech 2004b). In general, the core capability areas are medical devices, agriculture (e.g. plant and animal biotech, agrifood), natural product chemistry (including bioprospecting), human health (e.g. stem cells, drug discovery platforms), nanotechnology, clinical trial opportunities and industrial biotechnology (e.g. biomaterials, biopolymers, waste management).

Australia is home to around 470 biotechnology companies, ranging from start-ups to more developed companies selling products in Australia and overseas. These companies operate in the sub-sectors of health, industrial processing, agriculture and the environment (DIISRTE 2012). There are currently 100 ASX-listed life sciences companies, with a market capitalisation of $31.4 billion (AusBiotech 2012). This figure of 100 ASX-listed life science companies is different from the 61 in Table 2.20 due to the different classification of firms and source of databases.

For the early development of the Australian biotechnology industry, the Australian Biotechnology Report 2001 (Ernst & Young 2001) and the AusBiotech "An Industry Snapshot" presentation (AusBiotech 2004a) provide detailed information for the analysis of this sector. More recently, the annual BioIndustry Report published by Innovation Dynamics Pty Ltd has become the mainstream independent industry report for the Australian biotechnology industry. A summary of the Australian biotechnology industry between 2005 and 2007 is provided in

Table 2.22 (Hopper & Thorburn 2007; 2008). However, Hopper & Thorburn stopped publishing further industry report after 2008. This makes it very hard to collect local biotechnology industry data. This implies that only government data can be obtained which might be subjective in finding the real issues in that industry. Third-party and objective industry data are quite critical for further research in this important industry in Australia. Moreover, more entrepreneurship research should be done across various sectors in the biotechnology industry.

Table 2.21 Summary of breakdown of Australian biotechnology sectors (Source: AusBiotech 2004b)

Agriculture	Aquaculture/ Marine Biotechnology	Environment	Food Production and Processing	Forest Products	Human Health	Industrial Biotech & General Biochemicals/Fine Chemical Feed Stock	Medical Devices, Equipment/ Supplies and Bioengineer-ing	Mining/ Energy/ Petroleum/ Chemicals	Nanotech-nology	Specialist Service Provider
•Plant biotechnology (e.g. tissue culture, embryogenesis, genetic markers, genetic engineering, plant breeding, floriculture, forestry) • Animal biotechnology (e.g. diagnostics, therapeutics, embryo transplantation, genetic markers, genetic engineering, animal breeding, anti-microbials) • Biofertilisers, biopesticides, bioherbicides, biological additives, microbial pest control, hormones, pheramones, and other agrichemicals	•Fish health and nutrition (e.g. diagnostics, therapeutics) • Brood stock genetics and animal breeding (e.g. tracking superior traits, genetic modification, triploiding oyster seed) • Bioextraction and marine bioprospecting (e.g. polymers from seaweed, antifreeze, proteins from fish flavours, food additives from algae)	•Biofiltration and treatments (e.g. treatment of organic emissions to air/water) • Bioremediation, waste management, phytoremediation (e.g. clean-up of toxic waste sites using microorganisms, marine bio-fouling, animal wastes) • Diagnostics (e.g. detection of toxic substances using bioindicators, biosensors, immuno-diagnostics)	•Food processing (e.g. food products, food components, enzymes, yeasts, bacteria culture) • Functional foods, additives, nutrichemicals (e.g. probiotics, unsaturated fatty acids)	•Silviculture (e.g. ectomycorrhizae, tissue culture, somatic embryogenesis, genetic markers, genetic • Cleaner industrial bioprocessing (e.g. biopulping, biobleaching, biological prevention of sapstain)	•Diagnostics (e.g. immunodiagnostics, gene probes, biosensors) • Therapeutics (e.g. vaccines, immune stimulants, biopharmaceuticals, rational drug design, combinatorial chemistry) • Gene therapy (e.g. gene identification, gene constructs, gene delivery, xenotransplants) • Genomics/ Proteomics/ Bioinformatics/ Bioprospecting - genomics and molecular analysis (e.g. DNA/RNA/protein sequencing and databases for humans, plants, animals and microorganisms, structure function studies)	•Custom bio-synthesis of biologicals (e.g. peptides, proteins, nucleotides, hormones, growth factors) • Custom synthesis of fine chemicals (e.g. monomers, fuels, lubricants, fine chemical feed stocks, cosmetics)	• Equipment manufacture, instruments, consumables, reagents (e.g. development of stents, valves, monitoring of medical conditions, artificial limbs and structures, cochlear implants) •Bioengineer-ing, large scale fermentation and contract manufactur-ing, downstream processing	•Microbio-logically enhanced petroleum/ mineral recovery • Cleaner industrial bioprocessing (e.g. bio-desulphurisat-ion, biocracking, bio-recovery)	• New materials design, therapeut-ics, manufactur -ing processes (e.g. nano-structured porous silicon, dendrimers for pharma-ceutical activity)	•Contract research and development to the biotech-nology industry (e.g. high throughput screening, clinical trials) •Consulting to the biotech-nology industry (e.g. business development, legal and patent attorneys, communicat-ion and marketing, manufactur-ing, finance)

Table 2.22 Summary of Australian biotechnology industry between 2005 and 2007

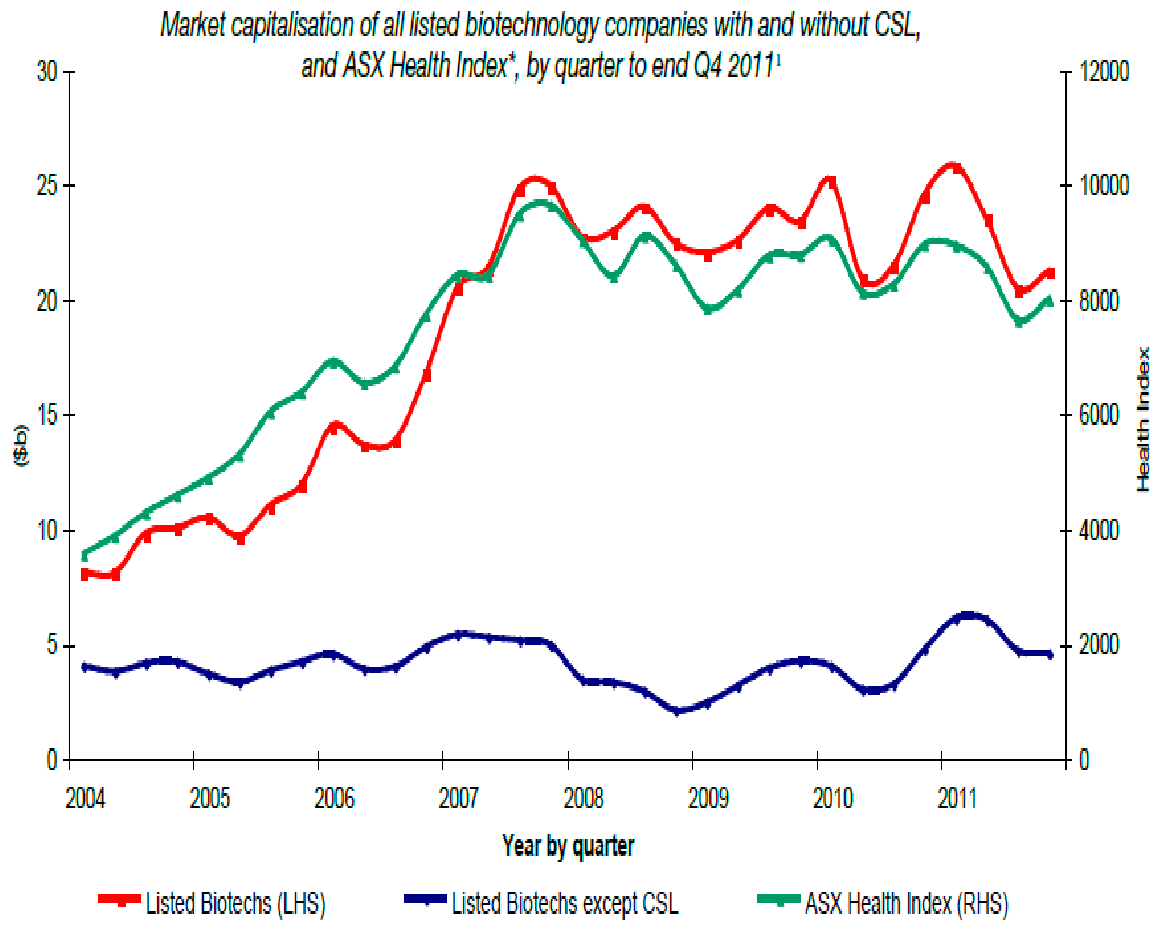
	2005	2006	2007
Biotechnology No. of core biotechnology companies	427	427	470
New firms formed in financial year	20	19	21
No. of listed biotechnology companies	83	76	82
Total market cap of the biotechnology companies on the ASX (December)	$11,613m	$15,246m	$24,849m
Total revenue of listed biotechnology companies	$3,068m	$3,275m	$3,897m
Medical Devices			
No. of medical devices companies	612	625	636
Growth in no. from previous year	8	13	9
No. of listed medical devices companies	45	48	56
Total market cap of the medical devices companies on the ASX (December)	$9,083m	$11,253m	$12,370m
Total revenue of listed medical devices companies	$2,074m	$2,640m	$2,955m
General Total employment (estimate)	N/A	12,100	N/A
Publicly announced international alliances	244	234	N/A

Source: Adopted from Hopper & Thorburn (2007; 2008)

Table 2.22 gives another perspective to understand the Australian biotechnology industry which might be slightly different to Table 2.20, in particular for the number of biotechnology companies. In Table 2.22, there were more medical devices companies than other biotechnology companies. There was no change in the number of core biotechnology companies between 2005 and 2006 while there was a 9% change in the number of core biotechnology companies between 2006 and 2007. Each year there were about 20 biotechnology companies formed, while there were about 10 medical devices companies formed. There were about 80 ASX-listed biotechnology companies when compared to about 50 listed medical device companies between 2005 and 2007. In general, biotechnologies companies could raise more market capital in ASX and had higher total revenue than listed medical devices companies.

Figure 2.12 compares the market capitalisation of all listed Australian biotechnology companies, including and not including CSL, to the ASX Health Care Index. The ASX Health Index is a broader category that includes healthcare, pharmaceutical, biotechnology and medical devices companies. During Q4 2011, the Health Care Index grew by 4.9% from 7616.8 to 7987.6 (Biotechnology Innovation Policy 2011)

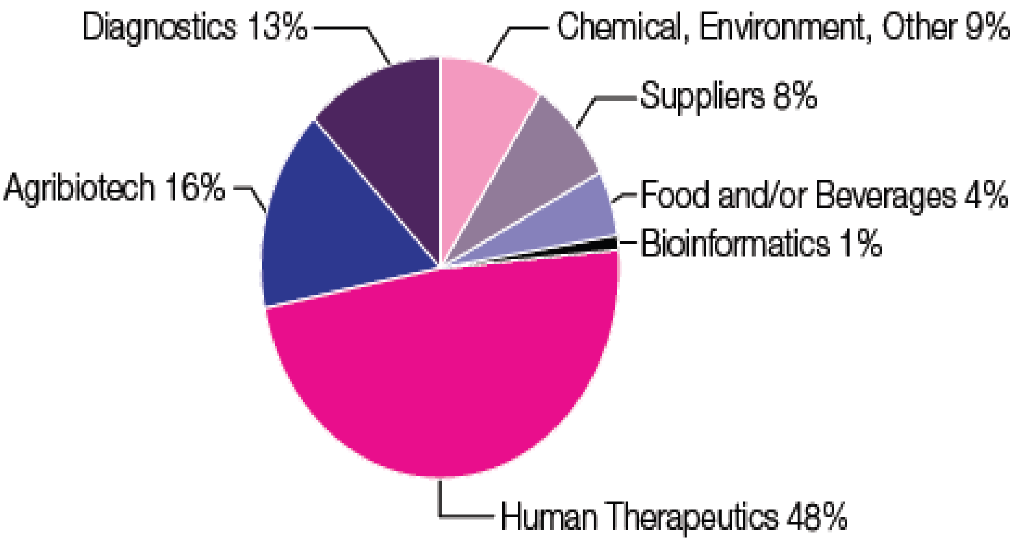
Figure 2.12 Australian Biotech Business Indicators Compared to ASX Health Index, (Q4, 2004)



Source: Biotechnology Innovation Policy (2011)

Human therapeutics remains the largest sub-sector of Australian biotechnology, with around 50% of biotech companies operating in this area, reflecting Australia's strengths in medical research (Figure 2.13).

Figure 2.13 Australian biotechnology companies by sub-sector, June 2008

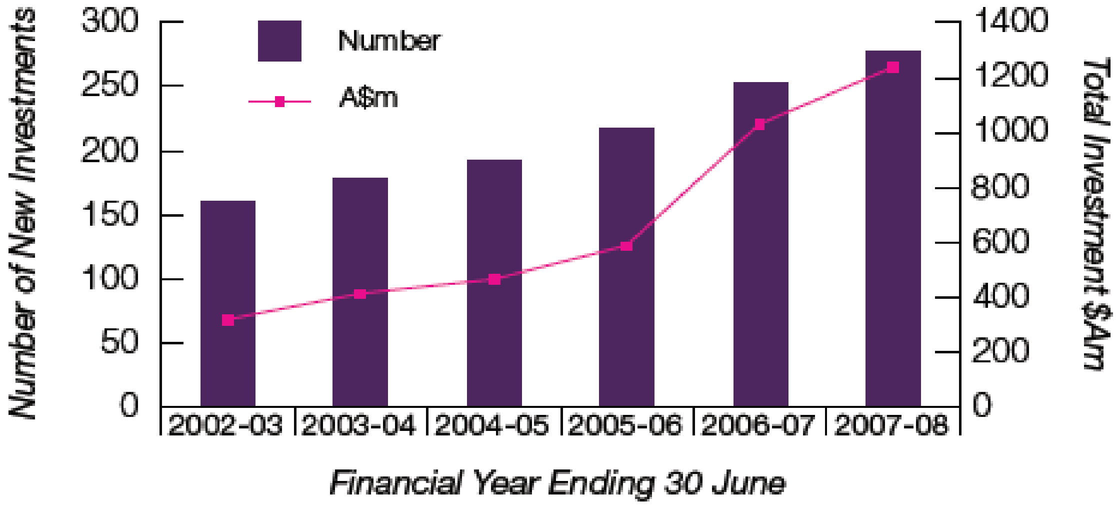


Source: Biotechnology Innovation Policy (2009)

In Figure 2.14, over A$4 billion in venture capital and later-stage equity investment has been directed to Australian companies in the biotechnology, pharmaceuticals and health sectors from 2002-2003 to 2007-2008 (latest data available). The number of new investments into these sectors has also steadily increased each year from 160 in 2002-2003 to 277 in 2007-08.

In 2007-08, the biotechnology, pharmaceuticals and health sectors captured 16% (A$1235m) of the total amount of venture capital and later-stage equity invested in Australia. The amount invested in the biotech sector in 2007-08 increased by 20% over 2006-07 (A$1028m) (Biotechnology Innovation Policy 2009).

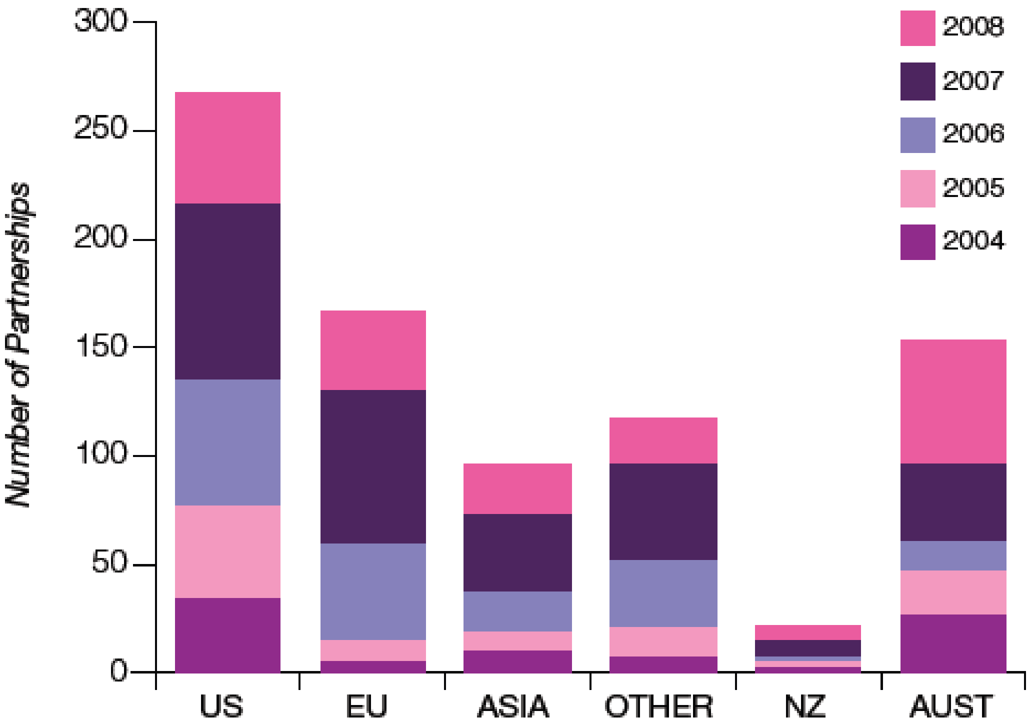
Figure 2.14 Venture capital and later stage equity in Australian biotechnology sector, 2002-2008



Source: Biotechnology Innovation Policy (2009)

After steady increases in partnerships from 2004 to 2007, there was a fall in 2008, with Australian biotechnology forming 196 partnerships in 2008 (down from 276 in 2007) (Figure 2.15).

Figure 2.15 Global biotechnology partnerships in Australian biotechnology sector in 2008 (Source: Biotechnology Innovation Policy (2009))



In the Australian biotechnology context, the sector is not performing well despite its efficiency, low cost and high quality of research and development. That is why Vitale (2004) claimed that "the Australian biotechnology sector is not yet successful". The sector faces numerous difficulties such as persistent and insufficient capital raising, unclear and inconsistent government policies, and the lack of capable and experienced senior management staff. Australian biotechnology firms suffer a significant disadvantage of raising far less money per investment round than their American and European competitors, and fewer rounds of offer before public listing (Vitale 2004). Without changes in attitudes and government policies, the Australian biotechnology sector will be consigned to perform below its potential in performance. Vitale and Sparling (2003) have suggested the possibility of consolidation through mergers and acquisitions in order to retain the competitive advantages of the sector for cash flow, profitability, and economy of scale.

The above observations and comments are also echoed by Herpin, Karuso and Foley (2005). Their recommendations are as follows:

> "The unique challenges faced by Australian companies, such as visibility, distance to key markets and potential commercial collaborators and lack of development funding, have resulted in a number of strategies being implemented. These include efforts to raise money, often prematurely and very discounted, through public markets in Australia and/or partnerships around very early, very high-risk development-stage projects with US/European pharmaceutical or biotechnology companies. In addition, a recent strategy has been to merge with or acquire another Australian or overseas small company."

Concerns have been raised whether Australia`s strength and capabilities can capitalise on biotechnology. Australia may not have the infrastructure to support the creation and growth of the emerging biotechnology industry. However, the Australian biotechnology industry is growing and generated A$1billion as the total revenues from the core biotechnology companies in 2002-2003 (AusBiotech 2004a). Throughout the growth process for Australian biotechnology a lot of difficulties have been faced such as barriers to commercialisation and innovation. These barriers will be determined in the survey of Australian biotechnology companies discussed in a later part of this thesis.

1. Barriers to commercialisation

Figure 2.16 lists the top four barriers to commercialisation for Australian biotechnology industry as a whole, as documented in the Australian biotechnology report 2001 (AusBiotech 2004a; Ernst & Young 2001):

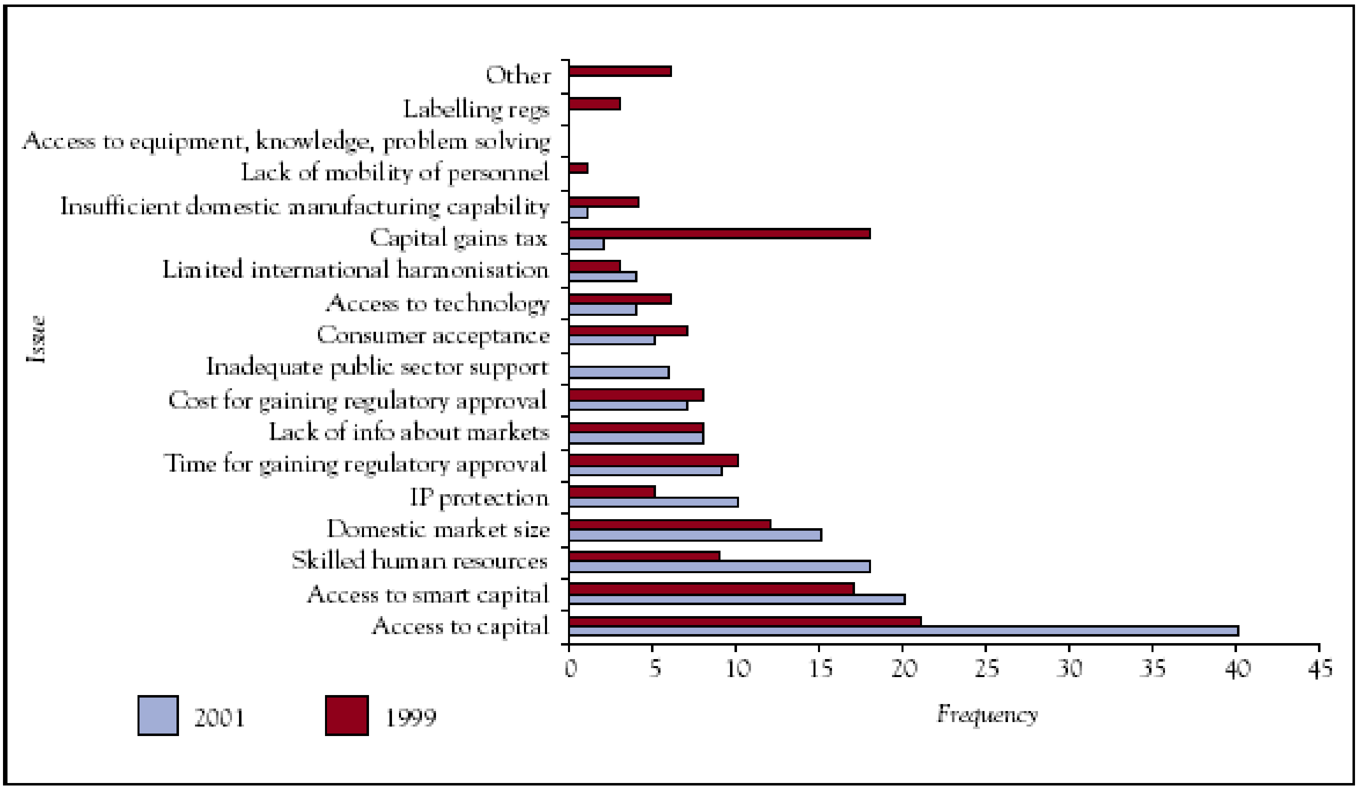
1. Access to capital including "smart" capital (funding bundled with expert management and tax advice) necessary to develop technology;

2. The availability of skilled human resources;

3. The relatively small size of the domestic market; and

4. Effective protection of intellectual property.

Figure 2.16 An Australian biotechnology industry perspective for barriers to commercialisation in 2001 (Source: Ernest & Young/Freehills/ISR survey and research data 2001)



There is a vigorous ongoing debate about the barriers to greater commercialisation of biotechnology in Australia. Venture capital is a large driver of growth in small life science companies. Australia needs to encourage venture capital investment by creating incentives for individual and institutional investment and wealth creation, especially through the creation of a globally competitive capital gain tax system and by actively promoting a community atmosphere to reward entrepreneurship. In contrast, many researchers in the science community contend that there is insufficient venture capital available to fund biotechnology companies. Some have argued that increased funding of fundamental science will strengthen the total science base and lead to greater rates of company creation. However, those in the finance community contend that money is available but there are not enough good deals presented to them. Financiers argue that, with the limited funds available in a country this size, there is already an over-emphasis on fundamental research. They argue there are insufficient resources devoted to developing management skills and creating technologies to make products commercially viable. These arguments are certainly not new, nor unique to Australia or the biotechnology sector.

Recent Commonwealth Government initiatives have drawn significant resources to the seed and early stage ventures with the discipline of experienced venture capital investors. While this is a very positive step, problems in the tax structure and the lack of relevant skills in management for early stage biotechnology companies will continue to challenge Australian biotechnology (Ernst & Young/Freehills/ISR survey and research data 2001).

The protection of intellectual property (IP) demonstrates a crucial step in the commercialisation of biotechnology innovations. Proper work done on the patent protection is essential to ensure the full recovery of investment in research and development as far as possible, due to the long pathway to regulatory approval. Australian inventors who are working in universities and research institutes face the obvious difficulty in finding the funding required to maintain patent coverage until potential investors or partners can be found.

The issues of skilled human resources come from finding the capable manager or corporate team to run the biotechnology business. The manager may not have the understanding of the nature of entrepreneurship in such entrepreneurial biotechnology business.

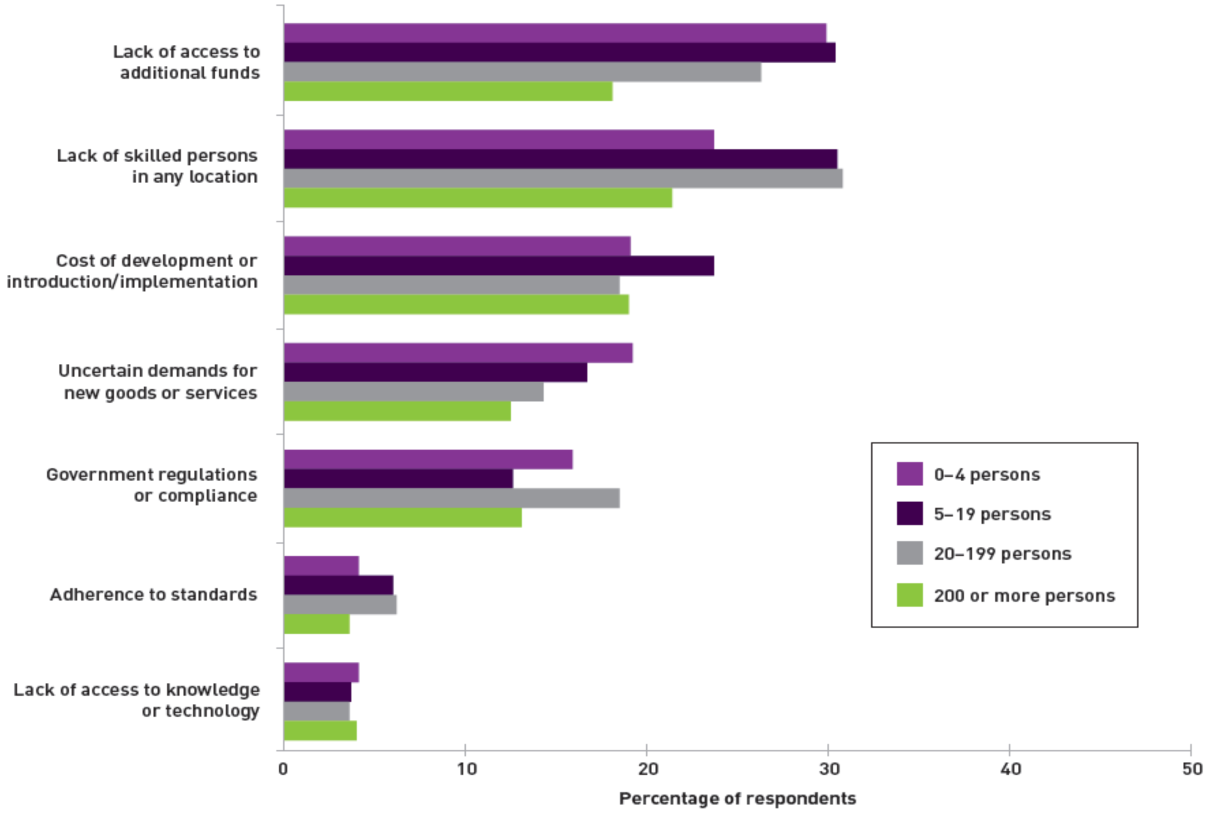
2. Barriers to innovation

Despite Figure 2.16 not having current information, the pattern of these four barriers to commercialisation in Australian biotechnology industry will still hold in today’s situation in which they reflect the simililar barriers to other industries.

Figure 2.17 displayed the status of innovative acitivies in Australian business between 2009 and 2010 (Commonwealth of Australia 2011, p. 56). The Australian biotechnology industry also participates in similar innovative activies. Since innovations are essentially market experiments, particularly for new goods and services, failure is an inevitable and important part of the innovation process. Early failures are important milestones because they generate systemic learning about how to identify real opportunities and how to address them. Once recognised, failures also quickly free up people, capital, and ideas for more promising projects. Many ideas and possible projects are weeded out as businesses assess their attractiveness and feasibility.

Figure 2.17 shows that a number of market experiments are abandoned every year by businesses (Commonwealth of Australia 2011, p. 56). Many firms do not survive the commercialisation process and are counted as business exits. This number could be up to 15% of the total pool of Australian businesses every year. These barriers are still present in the Australian biotechnology industry.

Figure 2.17 Summary of innovative activity in Australian business, by status, 2009-2010



Source: Commonwealth of Australia (2011, p. 56)

2.8 Chapter Summary

Chapter 2 covers the following topics: environmental dynamism framework, entrepreneurial type framework, entrepreneurial process model, leadership capacity framework, entrepreneurial leadership framework and overview of the Australian biotechnology industry.

Among the organisation theory and strategic management literatures, environmental dynamism (ED) is considered as one of the widely-explored constructs (Miles, Covin & Heeley 2000). Generally, environmental dynamism refers to the rate and instability of changes in an organisation's external environment (Aldrich 1979; Dess & Beard 1984). It manifests in the degree of instability or turbulence of key operating concerns such as market and industry conditions that is, more general economic, social, technological and political forces (Emery & Trist 1965; Dess & Beard 1984).

In the Entrepreneurial Type Framework section, first, it covers the discussion of entrepreneurial typology or type. Second, Miner's (1996; 1997 & 2000) four-way psychological typology will be discussed. Lastly, another entrepreneurial typology such as the Big Five model of personality traits is also introduced.

In the section of Entrepreneurial Process Model, it explains the concept and foundation of entrepreneurship with an overview of the definition of entrepreneurship, the major theories of entrepreneurship, the main approaches to entrepreneurship research and the entrepreneurial process model. The focus of discussion in this section is on the entrepreneurial process.

In the section of leadership capacity framework and entrepreneurial leadership framework, the following has been discussed: the review of leadership theories, the leadership capacity framework, the scope of entrepreneurial leadership; the intersection of entrepreneurship and leadership; leadership skills, behaviour and styles; and the significance of entrepreneurial leadership capacity (ELC) to entrepreneurial biotechnology industry. This ELC will help drive the drivers from the environment and the entrepreneur to go through the entrepreneurial process when the identified opportunities are considered to be viable for further exploitation. ELC is a new term in entrepreneurship research. Measuring instruments for determining entrepreneurial leadership capacity are not yet developed. This new conceptual model will further develop what the literature has known about leadership capacity and develop it into a new model of entrepreneurship incorporating the entrepreneurial leadership capacity. More discussion for this new model will be found in Chapter 3.

CHAPTER 3 DEVELOPMENT OF A NEW MODEL OF ENTREPRENEURSHIP WITH ENTREPRENEURIAL LEADERSHIP CAPACITY (EELC) FOR HIGH-TECHNOLOGY VENTURES

3.1 Chapter Introduction

High-technology entrepreneurship for new ventures in emerging economies has taken a critical role in the creation and growth of economies (Siqueira & Bruton 2010). High-technology is defined as the trade in exports and imports of products requiring a high amount of R&D in their development and/or production (Loschky 2009). In Table 1.1, five high-technology industries and nine high-technology product groups are identified (OECD 2005). In this study, more emphasis is on the sectoral approach for high-technology industries such as aerospace, pharmaceutical/biotechnology, computers and office equipment, electronics-communication and precision instruments (Loschky 2009).

Technical entrepreneurs have been acknowledged to be the key catalyst in the process of high-technology entrepreneurship. Besides their technical capability, these entrepreneurs have to develop an additional effective business or management skill such as leadership, marketing and personnel management in order to be successful in venture growth (Oakey 2003).

In the past, scholars agreed that leadership and entrepreneurship should be treated as two separate disciplines. As the failure rate of new ventures increased rapidly, more entrepreneurs realised the necessity of having effective leadership behaviour (Gupta, MacMillan & Surie 2004). This led to increased attention paid to leadership in the entrepreneurship literature (Cogliser & Brigham 2004; Vecchio 2003). Despite its considerable growing pains, leadership can now be considered as a “mature field” of discipline (Hunt & Dodge 2001). Since entrepreneurship is recognised as a “young field” in its early stages of theory development, those same issues struggled with by entrepreneurship scholars would have been faced before by the leadership scholars. By learning the lessons from the path of leadership research the growing pains brought to the scholars in entrepreneurship research can possibly be alleviated (Cogliser & Brigham 2004).

It is appropriate that a new research direction for entrepreneurship research should be based on an integrative approach (Morris et al. 2001). Darling, Gabrielsson and Seristo (2007, p. 19) says “The entrepreneurs who provide leadership in addition to merely managing their enterprises are the ones who have a higher potential for success”. This demonstrates the importance of management leadership in an organisation and entrepreneurial leadership in new venture growth by entrepreneurs. Entrepreneurs with the availability of information and availability of entrepreneurial leadership skills will have a higher chance to exploit entrepreneurial opportunities for ventures. Besides, each entrepreneurial type (personal achiever (PA), super sales people (SS), expert idea generator (EI) and real manager (RM)) with the presence of individual distinct personality will have the tendency or direction to pursue the entrepreneurial route for venture creation which he or she thinks is appropriate to follow (Miner 2000).

Leadership forms a central part of organisational capacity because leaders, in addition to representing the firm in the business arena, are responsible for setting organisational values and direction, and for inspiring employees to accept and work towards the mission and goals of the firm (Hinings & Greenwood 1989).

Besides, there are no researchers studying the relationships between the external and internal drivers of venture growth, the modes of opportunity exploitation (stand-alone venture or existing organisation) in the entrepreneurial process and the entrepreneurial type (PA, SS, EI and RM) using entrepreneurial leadership capacity as the mediating role in maintaining that relationship. This ELC, which will help drive the external and internal drivers from the environment and organisation, facilitates the entrepreneur to go through the entrepreneurial process when the identified opportunities are considered to be viable for further exploitation.

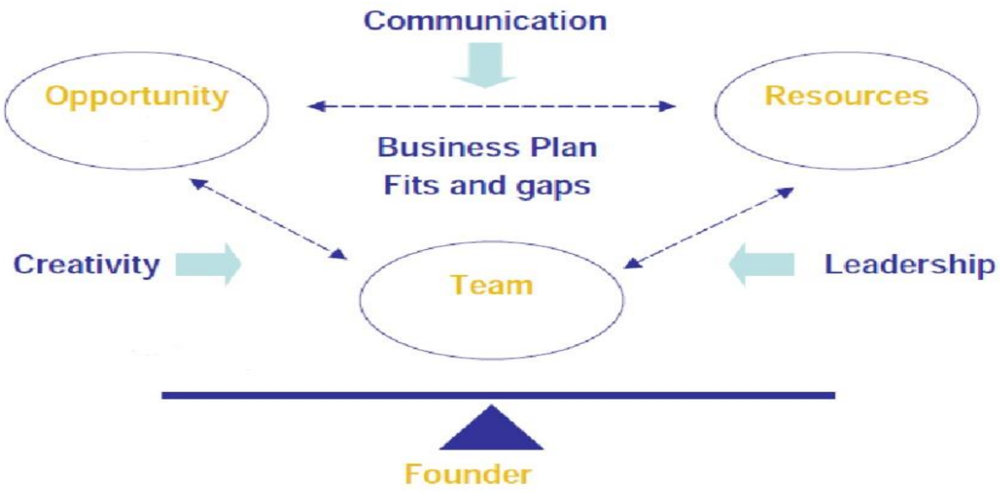
Because of the importance it is given in entrepreneurship research, the role of entrepreneurial leadership capacity of individual entrepreneurs can enhance the entrepreneurial process for high-technology ventures. In addition, the values and strategies of entrepreneurial leadership can provide distinguishing competitive advantages for entrepreneurial organisations from others in the achievement of excellence (Gaddefors 2007). The new model proposed here incorporates the ELC from various entrepreneurial types as the relationship moderator together with the other three widely-studied dimensions: the entrepreneur, the entrepreneurial process and the organisation. This model will be developed to provide a framework for understanding the relationship between entrepreneurs and venture growth. This new approach shifts entrepreneurship from a segmented school of thought to a dynamic and interactive process approach.

3.2 The Evolution of the New Model of Entrepreneurship for High-Technology Ventures

This section proceeds in the following manner. First, a detailed explanation of the evolution of this new model of entrepreneurship for high-technology ventures will be provided. Second, the needs and benefits of this new model will be examined. Third, the key constructs with hypotheses of this new model will be proposed, which consists of the specific linkage between the entrepreneurs and the entrepreneurial process through the entrepreneurial leadership capacity as the relationship moderator. Finally, the chapter closes with summary comments.

Timmons (1999) and Timmons, Gillin, Burshtein and Spinelli Jr (2011) verified that entrepreneurship is an opportunity-driven process. In Figure 3.1, Timmons model of entrepreneurship, which is normative, consists of three essential components or driving forces: opportunity evaluation, resource marshalling and entrepreneurial team formation. These three components are under the responsibility of the entrepreneur who can assess, influence, shape, and alter them. The entrepreneur plays a critical role in juggling all these three key driving forces in a changing and competitive environment. However, the genuine opportunity or market which is the most important driving force for an entrepreneur is much bigger than the talent and capacity of the team or the initial resources available to the team. The shape, size and depth of the opportunity will change the requirement of shape, size and depth of both resources and the team. In a well-managed entrepreneurial team with strong leadership, it is not critical to have all the resources in place prior to beginning a new venture. Money, strategy, business plan and other resources will follow high potential opportunities. Consequently, the entrepreneur or the entrepreneurial team will drive the process. The lead entrepreneur will act as both a player and a coach by demonstrating the appropriate leadership for the entrepreneurial team in pursuing the potential opportunities. Entrepreneurial leaders can recognise that even uncertain big opportunities can paralyse the entrepreneurial team with ambiguity. Leadership has the greatest influence on the connection between the opportunity and the team. Besides, entrepreneurial creativity can convince the team that value can be created and the necessary resources can be marshalled to exploit the opportunity. Finally, the concept of fit and balance with gap analysis between and among the three driving forces of opportunity, resources and team is critical for the success of the entrepreneurial process.

Figure 3.1 Timmons model of entrepreneurship



Source: Timmons (1999); Timmons, Gillin, Burshtein & Spinelli Jr (2011)

Before Timmons, past research led to findings that were somewhat fragmented or addressed just a single aspect of new venture creation (Morris et al. 2001). By taking into account the evolving and complex nature of entrepreneurship involving multi-disciplines and multiple stakeholders, a new approach involving various dimensions to study entrepreneurship can offer a better choice to fully understand the interrelationship between the phenomena (Gartner 1985; Johnson 1990; Kouriloff 2000; Yamada 2004). Gartner (1985) was one of the pioneers who proposed a multidimensional approach to study new venture creation, in his case consisting of four dimensions: the individual, the organisation, the environment and the new venture process. Gartner's approach (1985) also provides the foundation for this model of entrepreneurship for venture growth.

Morris et al. (2001) have worked towards an integration of a proposed "framework of frameworks" which consists of six key factors linking to eleven other frameworks (refer Figure 2.4).

Since entrepreneurial leadership has been identified as the most crucial factor in the management of high growth ventures which will add the competitive edge, many researchers have investigated the significance of entrepreneurial leadership in organisations (Oliver & Paul-Shaheen 1997; van Zyl & Mathur-Helm 2007; Darling, Keeffe & Ross 2007). Vecchio (2003) has proposed a comprehensive model of entrepreneurial leadership which incorporates both entrepreneurial process and context in differentiating effectiveness in entrepreneurial behaviour such as launching, managing, and exiting a new firm. Vecchio's (2003) model of entrepreneurial leadership has been adopted as the driving force between the entrepreneur and the entrepreneurial process for venture growth in this EELC model.

Although psychological typology related to entrepreneurial types has been widely studied (Miner 1996, 1997 & 2000; Garman & Phillips 2006), in the literature of entrepreneurship theories or frameworks there is no research studying the relationship of the modes of opportunity exploitation (stand-alone venture or existing organisation) (Shane & Venkataraman 2000) and the entrepreneur type (personal achiever (PA), super sales people (SS), expert idea generator (EI) and real manager (RM)) (Miner 2000) using the entrepreneurial leadership capacity (Vecchio 2003) as the moderating role in maintaining that relationship.

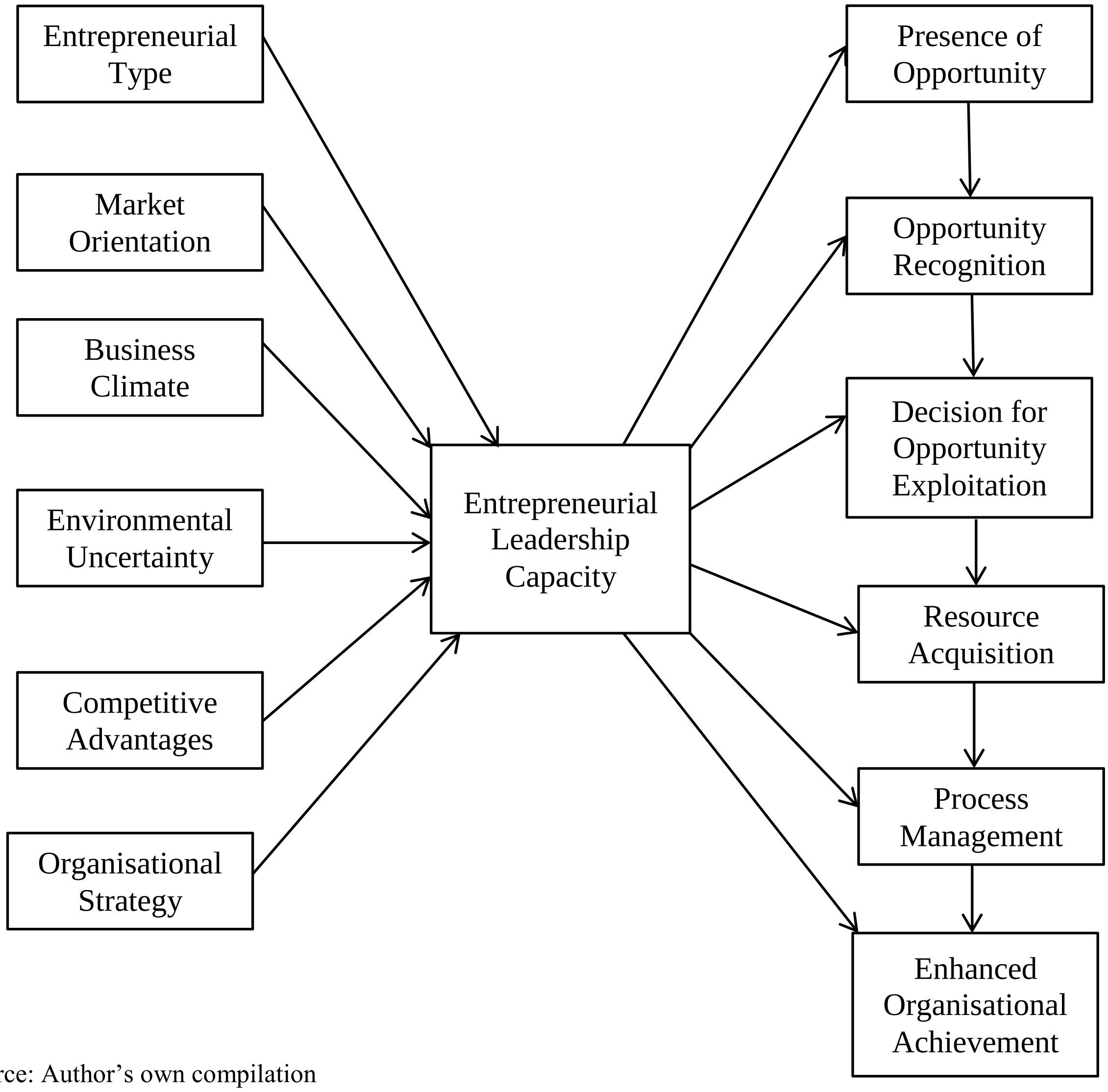
It is hoped the outcome of this new model (EELC) will further contribute to the knowledge of theory-building of entrepreneurship a bit more. This outcome of this study will also try to make the discipline of entrepreneurship as a domain of "mature field" away from its infancy of research. This EELC model will also contribute to the knowledge of the new direction for entrepreneurship research. All of the disciplines of entrepreneurship, leadership and study of high-technology and biotechnology industries will at least benefit from this new model of entrepreneurship with a better understanding of the interrelationship for successful high-technology ventures.

In this proposed model of entrepreneurship for high-technology ventures (Figure 1.1), it incorporates the entrepreneurial leadership capacity (ELC) as the relationship mediator (types of innovation, recognition of innovation barriers from financial, regulatory and resource perspectives) (Kuratko & Hornsby 1998; Hitt, Ireland & Hoskisson 2001) together with the four widely-studied dimensions as follows (Gartner 1985):

1. The entrepreneur (entrepreneurial types): Entrepreneurial type theory as the related theory for model development.
2. The external drivers (market orientation, business climate, environmental uncertainty and competitive advantages) and internal/organisational driver (organisational strategy): Environmental dynamism theory as the related theory for model development.
3. The entrepreneurial process (presence of opportunity, opportunity recognition, decision for opportunity exploitation, resource acquisition, process management): Entrepreneurial process model as the related theory for model development.
4. Enhanced organisational achievement (business models and enterprise performance): No particular model/framework found for model development.

In this new model, the framework for entrepreneurial leadership capacity is being developed in this study. The evolution of this EELC model for high-technology ventures will be discussed in detail in the following sections.

Figure 1.1 A new model of entrepreneurship with entrepreneurial leadership capacity (EELC) for high-technology ventures



Source: Author's own compilation

3.2.1 The Entrepreneurs

Many entrepreneurs rely entirely on their own capacity in pursuing an identified opportunity. The importance of the individual effort of the entrepreneur who creates organisations has long been appreciated and studied, in particular their "trait" characteristics. In the venture growth process, some entrepreneurs may turn to others for help with various aspects while others may start with a team, making the enterprise a collective effort in the exploitation of opportunity.

Because of the profound outcome of the team approach which is beyond the individual entrepreneurial effort, this has drawn a lot of attention to the study of the development of entrepreneurial team to the success of ventures (Clarysse & Moray 2004). The shift to research on the team-based approach is critical to the maturation of the development of entrepreneurship theories which increasingly explores new venture growth and management at multiple levels of analysis (Aldrich, Carter & Ruef 2004; Forbes, Borchert, Zellmer-Bruhn & Sapienza 2006). In the early stage of the entrepreneurial process, many venture capitalists will investigate the ‘‘business experience and quality’’ of the entrepreneurial team as an important funding criterion for investment consideration.

Five mechanisms of founding team composition have been studied, namely homophily (members with similar characteristic), functionality, status expectations, network constraint, and ecological constraints (Ruef, Aldrich & Carter 2003). Their findings suggest that homophily and network constraints based on strong ties with team members demonstrate the most pronounced effect on the entrepreneurial team composition (Ruef, Aldrich & Carter 2003). It seems essential to understand the composition and the formation of the entrepreneurial team for successful ventures. Despite the importance of the entrepreneurial team, this new model will focus only on the role of entrepreneurs in high-technology ventures.

In this dimension, one factor being investigated is entrepreneurial types (PA, SS, EI, RM) (Miner 2000).

Historically, entrepreneurs have been described as project undertakers, master builders, craftsmen, contractors, innovators, calculating inventors, and over-optimistic promoters, and entrepreneurial typologies have also been used in classifying technical entrepreneurs as the researcher, the producer, the user and the opportunist (Jones-Evans 1996). The term "entrepreneur" has drawn extensive research concerning the importance of its role in the success of technology ventures (Gans & Stern 2003; Oakey 2003; Peng & Shekshnia 2001). The dimension of entrepreneurs has had critical relevance to the successful ventures (Oliver 2004; Deeds & Hill 1996).

Typologies are commonly used in the study of entrepreneurship. The foundation of the proposed new model is based on the entrepreneurial type model from Miner's (1997) four-way psychological typology (FWPT) of entrepreneurs that includes personal achiever (PA), real manager (RM), expert idea generator (EI) and empathic super sales person (SS).

In this chapter's proposed new model, Miner's FWPT (1997) is adopted to classify the entrepreneurial types present in the various types of industry. It will be important to determine the distribution of these four entrepreneurial types within these venture companies.

The characteristics of personal achiever (PA) include the motivation for self-achievement, the desire for feedback on these and the desire to plan and set goals for future achievements (Miner 2000). A real manager entrepreneur has the desire to compete, be assertive and stand out for their success with a positive attitude towards authority and frequent use of power. Since the real manager (RM) does not have the same strong need for personal achievement as the other types do, they can more readily build collaborative teams.

Miner (2000) notes that the expert idea generators (EI) who may also be the inventors, have the desire to personally innovate; are conceptual in cognitive style; have high intelligence and the desire to avoid taking risks. They are problem-solvers. The last Miner's entrepreneurial type is the empathetic super sales person (SS), who is empathic in cognitive style and desires to help others

(Miner 2000). They place a high value on social processes and to harmonious social relationships, and they are anxious to help people with their problems.

Table 3.1 provides a full description of the routes to entrepreneurial success and the traps or pitfalls along the routes for various entrepreneurial types (Miner 1997). Mostly, these self-created traps, which often stem from the special psychodynamics of the individual, can lead to failure or at least temporary failure. These entrepreneurial success routes represent the alternative journeys entrepreneurs have to go through with the understanding of what it is, how and where to start, and how to avoid the traps leading to failure. Each entrepreneurial type will choose their own route that entrepreneurs can follow in search of success as entrepreneurs.

The routes to entrepreneurial success (*managing route*, *selling route*, *achieving route* and *idea generating route*) in Table 3.1 provide the alternative journeys that the entrepreneurs can choose for entrepreneurial start-up (Miner 1997).

An entrepreneur is different from a manager. A manager who has not founded the business is the person responsible for planning and organising the work of a group of staff, leading their work, and controlling with corrective action in an organisation (Robbins & Coulter 2005). A leader is an individual who can influence a group of people towards the accomplishment of a goal (Northouse 2007). An entrepreneur with different entrepreneurial type (PA, EI, SS and RM) needs to learn to be a leader in order to be successful in the entrepreneurial process for high-technology ventures.

Table 3.1 The routes to entrepreneurial success and the traps along the routes for various entrepreneurial types (Miner 1997)

Entrepreneurial Type	Entrepreneurial Success Route	Traps along the Route
<u>Personal Achiever</u>: -Need to achieve; -Desire for feedback; -Desire to plan and set goals; -Strong personal initiative; -Strong personal commitment to their organisation; -Belief that one person can make a difference; -Belief that work should be guided by personal goals, not those of others	**<u>Achieving Route</u>** 1. They are energetic, throwing themselves into the venture. 2. They learn whatever is necessary to run the business. 3. They plan goals, as well as strategies and timetables to reach them, and they constantly refine these along the way. 4. They are flexible, keeping the venture unstructured and responsive to opportunities and threats. 5. They solve problems, personally dealing with crises and the needs of the organisation.	1. They may not have sufficient knowledge to run the organisation. 2. They may not understand that they are personal achievers who must follow the achieving route to be successful. 3. They may be prevented from following the achieving route by corporate officers, bankers, or venture capitalists who want to impose structure and hierarchy of the organisation. 4. They may have conflicts with the needs of family members who resent the large amount of time and energy they invest in the venture. 5. They may stay on the achieving route even when the organisation reaches a size that requires more structure.
<u>Super Sales People</u>: -Capacity to understand & feel with another; -Desire to help others; -Belief that social processes are very important; -Need to have a strong positive relationship with others; -Belief that a sales force is crucial to carrying out company strategy	**<u>Selling Route</u>** 1. They are learning how to sell and learning about the product or service being sold. 2. They are sticking to selling. 3. They are providing for backup to handle the other aspects of the business.	1. They may have insufficient knowledge of the products and services they sell. 2. They may not fully recognise the super sales person within them. 3. They may be forced out of the selling route by other people or by circumstances; by their nature, they are particularly susceptible to this trap. 4. They may fail to traverse the growing pains that appear when the super sales person reaches a personal sales limit.
<u>Real Manager</u>: -Desire to be a corporate leader; -Decisiveness; -Positive attitude to authority; -Desire to compete; -Desire for power; -Desire to stand out from the crowd	**<u>Managing Route</u>** 1. They can manage their own employees, if there are a sufficient number of employees, and more than one level of management so that some organisation structure exists. 2. Those ones who have effective selling skills can manage people outside their organisation into buying the products or services of their firm. This activity is particularly attractive when their firm is small and there is little opportunity to manage internally.	1. They fail to accumulate the knowledge needed to manage well and the skills needed to convert this talent into action. 2. They over-manage or micro-manage a small venture with few employees, thus stifling the venture. 3. They stray off the managing route either out of a failure to understand that managing provides the best fit for his or her talents, or because circumstances convince a person that some other route is more appropriate.
<u>Expert Idea Generator</u>: -Desire to innovate; -Love of ideas; -Belief that new product development is crucial to carrying out company strategy; -Good intelligence; -Desire to avoid taking risks	**<u>Idea Generating Route</u>** 1. They become an expert in a specific field. 2. They have the freedom to use the expert knowledge to innovate. 3. They have the skills, or access to skills, that complement those of the expert idea generator.	1. Theirs ideas are stifled by people or circumstances beyond their control. 2. They fail to learn enough to become the expert that following the idea generating route requires. 3. They wander into areas where their expertise is no longer sufficient to yield a competitive edge. 4. They achieve so much success and become so confident of their ideas that they no longer apply risk avoidance to their thinking.

3.2.2 Drivers for High-Technology Ventures

Generally, according to the Business Dictionary Online, driver is defined as the following "(1) Condition or decision that causes subsequent conditions or decisions to occur as a consequence of its own occurrence; (2) Element of a system that has a major or a critical effect on the associated elements or the entire system; (3) Root cause of a condition or measurement" (Definition of driver 2012).

Driver and driving force are very similar in meanings. The definition of driving force is "the key internal forces (such as knowledge and competence of management and workforce) and external forces (such as economy, competitors, technology) that shape the future of an organisation" (Definition of driving force 2012).

Besides, when the drivers are applied as business drivers, they are defined as "people, knowledge, and conditions (such as market forces) that initiate and support activities for which the business was designed" (Definition of business drivers 2012).

By differentiating the similar meanings of drivers, driving force or business driver, they provide a better understanding of the two drivers that are being examined in this study: external and internal drivers. In the context of finance, external drivers can be referred as "the factors which are outside the company's influence that can affect profitability, for example, the economy, inflation, interest rates, politics, bond market, etc. External drivers can be interpreted differently by different individuals" (Chartfilter 2012a). In addition, the internal drivers are "company factors that are directly related to the actual business in question, for example, liabilities, assets, revenue, income, products and management etc." (Chartfilter 2012b).

In management research, the external drivers can be kinds of situations, or events that occur outside of the company which are by large beyond the control of the company such as the economy, the industry itself, competition, demographics and political interference etc. At the same time, internal driving forces are those situations or events that occur inside the business that are generally under the control of the company, for example, organisation of machinery and equipment, technological capacity, organisational culture, management systems, financial management and employee morale (Robbins & Coulter 2005).

3.2.2.1 External Drivers

In this study, the external drivers include market orientation, business climate, environmental uncertainty and competitive advantages. Environmental dynamism theory is used as the related theory for the study of external drivers in this new model.

Market Orientation

Market orientation (MO) can generally be defined as "a business approach or philosophy that focuses on identifying and meeting the stated or hidden needs or wants of customers" (Definition of market orientation 2012).

In the marketing literature, market orientation was firstly defined as an organisation-level culture involving the values and beliefs of putting the customer first in business planning (Renko, Carsrud & Brännback 2009). As the concept develops further, market orientation has been approached both as an aspect of organisational culture and as a behavioural phenomenon (Day 1999; Slater & Narver 1999). A set of behaviours is relating to (1) organisation-wide market intelligence generation through decision support systems, marketing information systems and marketing research efforts, (2) dissemination of the intelligence across functions in a firm, and (3) organisation-wide responsiveness (actions) based on this intelligence (Kohli & Jaworski 1990). Alternatively, market orientation has a set of externally focused behaviours involving (1) the collection of intelligence on customer needs and the external forces that shape those needs, (2) the extent the obtained external intelligence is disseminated within the firm, and (3) the action taken in response to the intelligence that is generated and disseminated (Jaworski & Kohli 1993).

Market orientation has characteristics defined as “the cyclic process of information acquisition about an organisation’s environment, the distribution and interpretation within the organisation of this intelligence, and the organisation’s responsive action” (Renko, Carsrud & Brännback 2009). On the other hand, in order to maintain a competitive advantage within the focal market, market orientation occurs when core organisational competencies are continually developed and refined. In simple terms, the process involves the monitoring of customers and competitors, where this information is then distributed and interpreted within the organisation, with responsive action, both internally and externally, being taken (Kohli & Jaworski 1990).

In addition, Narver and Slater's (1990) work defines market orientation as having three tenets: customer orientation, competitive orientation, and inter-functional coordination, which have different effects on the R&D effectiveness of high-technology firms. Inter-functional coordination has a positive simple effect. The effect of customer orientation is moderated by knowledge integration, and competitor orientation has no effect on the R&D effectiveness (De Luca, Verona & Vicari 2010).

Among the numerous studies, market orientation has been found to link to the followings: (1) short- and long-term performance under various environmental conditions (e.g. Dobni & Luffman 2003; Hult, Ketchen & Slater 2005); (2) organisational innovativeness and new-product performance (Kirca, Jayachandran & Bearden 2005); (3) marketing and corporate entrepreneurship (Barrett & Weinstein 1998); (4) firm's market orientation (e.g. Atuahene-Gima 2005; Im & Workman 2004); (5) firm's marketing competencies (Danneels 2002; Dutta, Narasimhan & Rajiv 1999) on innovation processes for the benefits of the presence of a market orientation in the development of innovations in high-technology; (6) learning organisations (Nasution, Mavondo, Matanda & Ndubisi 2011); (7) knowledge management and performance (Wang, Hult, Ketchen & Ahmed 2009) and (8) leadership (van Zyl & Mathur-Helm 2007).

Moreover, entrepreneurs who work within high-risk levels are more likely to be market orientated (Harris & Ogbona 2001). High market orientation level reduces uncertainty in the business, therefore lowering the need for taking risks (Esteban, Millán, Molina & Martín-Consuegra 2002). Low risk can be taken along with pro-activeness, which is another capability of an entrepreneur to take calculated risks (Goleman 1998). Since small companies are more responsive and pro-active towards market orientation (Becherer, Halstead & Haynes 2001), it would therefore appear that proactive entrepreneurs could use market orientation as a mechanism to reduce risk.

Matsuno, Mentzer, and Ozsomer (2002) suggest that the greater the level of entrepreneurial proclivity, the greater the level of market orientation. In this sense, organisations with higher levels of market orientation tend to place more emphasis on entrepreneurship (Matsuno et al. 2002).

Business Climate

Despite the established importance of business climate, the elements that constitute "business climate" remain broad and the concept is elusive and hard to define (Weaver, Liguori & Vozikis 2011). According to Business Dictionary Online, business climate is referred as “the general economic environment comprising the attitude of the government and lending institutions toward businesses and business activity, attitude of labour unions toward employers, current taxation regime and inflation rate” (Definition of business climate 2012).

According to OECD (2011), in a broad sense the business climate includes a very large number of factors, including levels of human capital, natural resource endowments, the size of domestic markets, infrastructure, administrative burdens, distance from foreign markets, the tax burden, the efficiency of civil administration, the incidence of corruption and the extent to which the rule of law applies (OECD 2011). “Hard” and “soft” factors can be broadly divided for the factors determining the attractiveness of a given business environment. Hard factors are those which, in the short term at least, can be taken as exogenous, such as market size, remoteness, natural resource endowments, the level of human capital and infrastructure. “Soft” factors broadly relate to institutions that may create barriers to business activity, including regulation, corruption, and public administration (OECD 2011).

In the literature, data have been provided as evidences that a good business climate favours growth by encouraging investment and higher productivity. Various infrastructure, finance, security, competition, and regulation variables have been shown to have a significant impact on enterprise performance (Dethier, Hirn & Straub 2011).

In addition, business climate will improve economic growth. Among many structural, institutional, and behavioural variables that shape and drive economic growth, infrastructure, access to finance, security (meaning the absence of corruption and crime), and the regulatory framework, including competition policies and the protection of property rights are the critical variables that collectively define the business climate (also called investment climate) (Dethier, Hirn & Straub 2011). Given the complexity of the effects that changes in the business climate elicit, different firms, industries, and regions will be affected in different ways. Moreover, growth fuelled by the business climate is not simply a shift toward some technological frontier. Developing countries must overcome or reduce all kinds of obstacles to efficiency, dynamic and otherwise, without any illusions that the economy will soon reach the frontier. Indeed, changes in the business climate may have their most crucial impact far from the technological frontier (Dethier, Hirn & Straub 2011).

A weak business climate may not only discourage investment. It can also lead businesses to take costly or counterproductive steps to defend themselves from the consequences of its weaknesses. On the contrary, improvements in the business climate could generate extra growth dividends through political economy mechanisms if they increase the number of people and enterprises with a stake in a better climate. And higher incomes might lead to pressure for an improved business climate in other ways, as people seek rules governing the protection of wealth or capital (Dethier, Hirn & Straub 2011).

According to the 2005 World Development Report, a good business climate drives growth by encouraging investment and higher productivity (World Bank 2004). At least four aspects of the business climate—infrastructure, finance, corruption and crime, and competition and regulation—have been shown to have a significant impact on firm performance (Dethier, Hirn & Straub 2011). An economy is said to have a sound business climate when it dwells in stability and openness in economic and political policies; efficient, transparent and effective governance and regulatory systems; and availability of the required infrastructure to support economic activities grow and thrive. A sound business climate encourages investments and entrepreneurship needed for growth and development (Mensah 2012).

Environmental Uncertainty

The importance, types, nature, dimensions, and the role of environment for an organisation's management have been widely studied by researchers (Duncan, 1972; Dess & Beard, 1984; Milliken, 1987; Ward, Duray, Leong & Sum 1995). In the literature, observable recurring studies found that changes in the environment are a source of considerable uncertainty for firms. According to the classical economic theory of supply and demand, if the environment were stable, it could be predicted that it would pose no immediate risk to firms. However, the environment does change and thus it cannot be taken as given, nor predicted perfectly. As a result, this change in environmental conditions poses uncertainty for firms, commonly referred to in organisational research as environmental uncertainty (Liu, Shah & Babakus 2012).

Early in the study of organisational research, Dill (1958) makes the classification of different components of the external environment that bring about uncertainty, for example, "general" and "task" environments. The task environment consists of elements and sectors with which the company has direct contact and that directly affects business strategy, day-to-day operations, and goal attainment. In the organisation theory, the task environment has been initially defined to include the sectors of customers, competitors, suppliers and regulatory bodies. In addition, the strategic management theory further expands the concept of task environment with the inclusion of the broader concept of business micro environment, which identifies the key forces (sectors) that govern competition in an industry. These forces are customers, competitors, suppliers, potential incomers, substitute products, and providers of complementary products (Vecchiato 2012). On the other hand, the general environments that affect the firm indirectly are the political, economic, ecological, societal, and technological (PEEST) landscapes that surround the business micro environment and today are commonly referred to as the business macro environment (Fahey & Randall 1998).

Since environmental uncertainty has long been viewed as a central problem of organisations (March & Simon 1958; Thompson 1967), a significant amount of theoretical and empirical effort has been devoted to understanding the nature and effects of environmental uncertainty on organisations (Jauch & Kraft 1986; Milliken 1987). Such efforts have been devoted primarily to such substantive research issues (Schwab 1980) which have the nature of the theoretical relationships among environmental uncertainty, and variables such as firm strategy (Hitt, Ireland & Palia 1982), economic performance (McCabe 1990) and organisational structure (Koberg & Ungson 1987).

Environmental uncertainty indicates the sense of unpredictability and imperfect knowledge about the environment (Verdu, Tamayo & Ruiz-Moreno 2012). Finally, environmental uncertainty has also been defined as an inability to anticipate fast changes in economic conditions (Dess & Beard 1984; Krishnan et al. 2006). It has also been defined as unpredictability or instability in the markets (Aldrich 1979) or technological fields (Moorman & Miner 1997). This requires significant scanning of the industrial condition in order to acquire accurate and reliable information that will enable the new venture to interpret and act upon the risks and threats facing it (Krishnan et al. 2006).

In an uncertain environment, a new venture moves quickly to reconfigure resources and modify competitive strategies. By occupying a central position in the industry and interacting with co-operators, the new venture is able to gain quick access to resources and information, which will enable it to reduce risks. With limited resources and capital, a new venture needs to maximise its ability to acquire information, obtain critical resources, and reduce costs. A central position can assist the new venture in obtaining diverse information; however, in an uncertain environment, strong relationships with co-operators restrict creation and innovation, as homogeneous information and knowledge are delivered to both the new venture and its co-operators (Wang & Fang 2012).

The relationships between competitive strategy, supply chain strategy, and business performance (BP) have been investigated and how environmental uncertainty moderates these relationships (Yinan, Xiande & Chwen 2011). Environmental uncertainty influences the development of both competitive and supply chain strategies. Hitt, Ireland, and Palia (1982) concluded that perceived environmental uncertainty can affect the choice and implementation of strategyEnvironmental uncertainty plays an important role in the choice of supply chain strategy. When competing in a stable environment, cost leaders need to place higher emphasis only on lean supply chain strategy. In contrast, in an unstable environment, where market mediation costs or the cost of the mismatch between supply and demand (e.g. costs of inventory obsolescence, markdowns, and stockouts) dominate the total costs (Fisher 1997), improving lean capabilities without improving agile capabilities will not suffice to achieve cost advantages. Therefore, higher environmental uncertainty demands that the firm place higher emphasis on agile strategy.

When a company adopts a differentiation strategy, environmental uncertainty does not significantly influence the emphasis on lean supply chain strategy. This is because differentiators compete based on unique product features or brand image, and they often charge a price premium without the emphasis on cost reduction. Therefore, companies that emphasise differentiation do not increase their emphasis on lean strategy regardless of the environment. However, differentiators must capture changes in customer preferences, and design and introduce new products with unique new features that competitors cannot provide. Consequently, a differentiator should increase its emphasis on an agile strategy (Yinan, Xiande & Chwen 2011).

Competitive Advantage

In simple definition, competitive advantage is defined as "a superiority gained by an organisation when it can provide the same value as its competitors but at a lower price, or can charge higher prices by providing greater value through differentiation. Competitive advantage results from matching core competencies to the opportunities" (Definition of competitive advantage 2012).

Generally, competitive advantage indicates that an enterprise can earn more business performance than its competitors in the same industrial area by utilising its assets and/or competencies. There are two schools of theories about competitive strategies that may affect competitive advantage. One of them is represented by Porter (1985, p. 26):

> "Competitive advantage describes the way a firm can choose and implement a generic strategy to achieve and sustain competitive advantage. It addresses the interplay between the types of competitive advantage – cost and differentiation – and the scope of a firm's activities.

> The basic tool for diagnosing competitive advantage and finding ways to enhance it is the value chain, which divides a firm into the discrete activities it performs in designing, producing, marketing, and distributing its product."

In fact, competitive advantage explains their positioning theories of competitive strategy structure, and uses "five forces" to analyse the competitive advantage of an industry (Porter 1985). They suggest that an enterprise ought to choose a proper industrial position, to make its competitive pressure lighter, or to adopt some actions on its rival firms to earn its own benefits (Porter 1985). Firms can enhance their chances for survival, growth, competitiveness and profitability by implementing strategies to gain competitive advantage.

The other school is a resource-based view presented by Wernerfelt (1984). They suggest that the competitive advantage of an enterprise should build on the basis of its core competencies that include tangible and intangible resources.

The competitive advantage has to be sustainable. Jacobson (1988) and Porter (1985) define sustained competitive advantage as a competitive advantage that lasted a rather long period. An enterprise with competitive advantage needs to offer better customer's value and/or low cost, thus might obtain a higher market share and higher financial performance (Hunt & Morgan 1995). Such competitive advantage should possess the following characteristics (Lee & Hsieh 2010):

1. Sustainability: An enterprise should lead its rival firms and sustain a rather long period, and cannot be run after by its rival firms in rather short period by means of imitating to obtain the same competitive advantage.
2. Uniqueness: An enterprise needs to have competencies owned by only a small number of firms.
3. Substantiality: An enterprise needs to lead its rival firms with a significant gap.

Entrepreneurship has been praised as the engine for firm creation and economic growth. Although various perspectives on entrepreneurship have been discussed, such as opportunity discovery, resource mobilisation, and firm organisation, the ultimate manifestation of entrepreneurial spirit is new venture creations (Chiang & Yan 2011). Entrepreneurship does not exist only in new-found technological firms, but also exists in the present and big firms that have a long history (Drucker 1985). Drucker (1986) points out that entrepreneurship is a kind of behaviour based on some concepts and thoughts.

Since the word “entrepreneurship” conjures up a positive image of being bold and innovative, researchers generally see corporate entrepreneurship (CE) as positively related to competitive advantage (Zahra 1996). For example, there is a belief that “entrepreneurship is an essential feature of high-performing firms” (Lumpkin & Dess 1996). However, it seems unlikely that CE always has positive effects on a firm’s competitive advantage. Empirical research has shown that an entrepreneurial strategy works under certain conditions but not others (Covin & Slevin, 1989). The contingent relationship between CE and environmental and organisational variables has received increasing support (Dess, Lumpkin & Covin 1997).

The strategy taken by a firm in practice can be as a market leader or as a second mover. For the former, the firm relies more on innovation, while the latter most resorts to imitation. Although innovation is the engine for the growth of the firm with relatively lower capabilities, this is not a competitive strategy for firms in developing countries, particularly at their early stage of development. A significant competitive advantage can be gained by employing imitation techniques. Rather than seeking new product innovation, which requires costly research, development, innovation, marketing, and branding capabilities, accompanied by a higher risk of product failure, imitation helps benefit from the experience of pioneers (Bolton 1993).

3.2.2.2 Internal Driver

In this study, the internal/organisational driver is organisational strategy. Environmental dynamism theory is used as the related theory for the study of internal driver in this new model.

Organisational Strategy

In today's ever-increasing high-technology, global environment, organisations all around the world are constantly facing challenges to have a competitive advantage. The global world is characterised by more competition, new technological changes, diverse workforce and continuously changing customers' needs etc. (Gupta 2011). Organisations must constantly adapt in order to succeed and survive. Every organisation must develop and maintain an acceptable alignment with its environment. Organisation and management theorists are increasingly viewing strategy as the mechanism that guides environmental alignment and provides integration for internal operations (Snow & Hambrick 1980).

The word strategy is derived from the Greek *strategos* — literally, "the art of the general" (Hart 1967). In fact, the concept of strategy apparently was introduced into the organisational literature and advanced most notably during the 1950s by faculty members at the Harvard Business School. The Harvard view of the strategy was (and is) normative, in that strategy was treated as a situational art, an imaginative act of integrating numerous complex decisions (Andrews, Learned, Christensen & Guth 1965; Andrews 1971).

Generally, organisational strategy is described as

> "an expression of how an organisation needs to evolve over time to meet its objectives along with a detailed assessment of what needs to be done. Developing an organisational strategy for a business involves first comparing its present state to its targeted state to define the differences, and then stating what is required for the desired changes to take place." (Definition of organisational strategy 2012).

Organisational strategy can also be defined as a plan for interacting with the competitive environments to achieve organisational goals (Daft, 1995, p. 49). The study of organisational strategy started with Collis and Montgomery (1995) who defined strategy as the match between what an organisation can do within the universe of what it might do. Later researchers, as represented by Porter (1980), focused on the industrial environment of an organisation and concluded that the structural characteristics of an industry determine the strategy of organisations in it. In addition, organisational strategy can be defined as the determination of the fundamental long-term goals and objectives of an organisation, and the adoption of courses of action and the allocation of resources necessary to attain these goals (Chandler 1962). It is designed to give a firm a competitive edge over its rivals in the same industry. Two of the most widely accepted typologies for generic competitive strategy are those of Miles and Snow and of Porter taxonomy (Douglas & Rhee 1989). The Miles and Snow taxonomy emphasises organisational strategic orientation, and classifies generic business strategies into four types, namely reactors, defenders, prospectors and analysers (Miles & Snow 1984). The Porter taxonomy focuses on achieving competitive advantage, and categorises strategy types as overall cost leadership, differentiation and focus. The focus strategy, in which the organisation concentrates on a specific market or buyer group, is further classified into focused low cost and focused differentiation (Porter 1980).

According to Miles and Snow (1978), most organisations can be categorised as having one dominant type of adaptation strategy: prospector, defender, analyser, or reactor. *Defender* organisations are successful well-established firms with a narrow product-market domain. Because of their limited focus, the defenders' primary attention is geared toward improving the efficiency of their existing operations. *Prospector* organisations are innovative firms that are constantly on the lookout for potential or emerging opportunities. However, the prospector's innovative approach to both products and markets can cost it in operating efficiencies. *Analyser* organisations constantly watch the market and assess their competition. They rapidly adopt those innovations that they deem most promising. In contrast, *reactor* organisations are slow to make adjustments to the market. Only strong environmental pressure will force a reactor organisation to adopt innovation or change.

Several empirical studies have found that the defenders, prospectors, and analysers outperform reactors, but there are mixed findings as to whether defenders, prospectors, and analysers are equally effective (Zahra & Pearce 1990).

Many organisations have turned to formal leader development programs to meet the challenges of ever-increasing high-technology and global environment (Reichard & Johnson 2011). Although investing in human resources is likely a key to success (Pfeffer 1994), organisations need different, more cost effective, and adaptive strategies for developing leaders. One approach is to implement leader self-development as organisational strategy. Self-development translates into an enhanced ability to solve problems quickly and generate creative ideas that support organisational adaptability and growth (Phillips 1993). Thus, learning organisations composed of self-directed learners who are inclined to self-develop have an edge over the competition (Antonacopoulou 2000). Leader self-development not only enables organisations to keep up with the dynamics of a changing environment (Antonacopoulou 2000), but is also a cost-effective way of developing human resources (Temporal 1984). However, for leader self-development to be a successful organisational strategy, it must be aligned with multiple organisational and group level practices. It takes time to design and implement a formal content specific leader development program and the needs of the organisation may have changed due to dynamic environmental factors (Reichard & Johnson 2011).

In defining leader self-development, Day's (2000) distinction between the concepts of leader development and leadership development is important because when an organisation's strategy supports leader self-development the result is not only an increase in individual leader capacity but also the organisation's leadership capacity as a whole. As Day (2000) noted, leader development focuses on the individual-level development, such as the knowledge, skills, and abilities required by formal leadership roles. Leader development usually takes the form of formal training, job rotation, or off-site workshops where the instructor or coordinator of the program determines what and how the leader will learn. In contrast, leadership development involves building social capital, including networked relationships among employees. Leadership development emphasises building and using interpersonal competence. In summary, while leader development focuses on an individual level process of building human capital, leadership development expands the collective capacity of employees and the building of social capital (Reichard & Johnson 2011).

3.2.3 Entrepreneurial Leadership Capacity

Entrepreneurial Leadership

Before discussing entrepreneurial leadership capacity, entrepreneurial leadership needs to be defined and understood. Entrepreneurial leadership refers to the intersection of the characteristics of the "entrepreneurship" and "leadership" concepts. Entrepreneurship forms the basis for competitive advantage and technological growth in all types of firms having orientation towards leadership and excellence in the new global economy (Gupta et al. 2004).

Various definitions have been given to entrepreneurship leadership in the process of research. Ireland and Hitt (1999) describe it as the influencing process of an individual to others for strategic resource management both in opportunity-seeking and advantage-seeking behaviours. Swiercz and Lydon (2002) refer to entrepreneurial leaders as individuals with the ability/capacity to initiate, develop and manage entrepreneurial organisations. Gupta et al. (2004) define entrepreneurial leadership as the leadership having the creation of visionary scenarios for the assembly and mobilisation of a "supporting cast" of participants who have committed to the vision for the discovery and exploitation of opportunity for strategic value creation. Morris et al. (2004) propose that:

> "successful entrepreneurial leadership can generally be thought of as leading, through direct involvement, a process that creates value for organisational stakeholders by bringing together a unique innovation and package of resources to respond to a recognised opportunity. In fulfilling this process, entrepreneurs function within a paradigm of three dimensions: innovativeness, risk-taking, and proactiveness".

According to Kuratko and Hornsby (1998), the major driving forces behind entrepreneurial leadership are the revitalisation of creativity, innovation and corporate management development which include the development of these specific elements such as vision, innovation, venture team and the structure of an entrepreneurial climate. In this chapter, the adopted definition of entrepreneurial leadership is by Hitt et al. (2001) as:

> "the entrepreneur's ability to anticipate, envision, maintain flexibility, think strategically, and work with others to initiate changes that will create a viable future for the organisation".

Entrepreneurial leadership will consist of these three distinct areas based on its definition from Hitt et al. (2001) and Kuratko and Hornsby (1998):

(1) Creativity and innovation

(2) Research and development

(3) Knowledge management.

The scope for entrepreneurial leadership as the mediator consists of the following areas: creativity (Chen 2007), innovation (Jung, Chow & Wu 2003; Montes, Moreno & Morales 2005), research and development (R&D) (Elkins & Keller 2003) and knowledge management (e.g. IP protection) (Newman 2006; Hemlin 2006). Many research studies have explored the impact of these areas on the organisation (Bencsik & Bognár 2007; Floyd & Woolridge 1999; Garcia-Morales, Llorens-Montes & Verdu-Jover 2006; Senker 1996; Chataway, Tait & Wield 2004). Moreover, extensive literature has also demonstrated that leadership plays an important role in improving company performance by involving these areas in the defined scope (Hemlin 2006; García-Morales, Lloréns-Montes & Verdú-Jover 2008; Schneider 2002; Ensley, Hmieleski & Pearce 2006; Tarabishy, Solomon, Fernald Jr. & Sashkin 2005). Some of these areas are interrelated. With the entrepreneurial leadership capacity, it can enhance the success rate for start-up firms. It is not enough just to have the knowledge and experience of the entrepreneurial process for ventures. Entrepreneurial leadership capacity will be required in addition to product ideas and/or technology (Foller 2002).

(1) Creativity and innovation

Entrepreneurial leadership can stimulate the creativity of entrepreneurial team members, which can improve a new venture's innovative capability (Chen 2007). Without creativity, it is hard to have innovation in high-technology firms. Entrepreneurial leadership should promote team cohesion and allow the organisation to learn through communication, dialogue, experimentation or the process of organisational knowledge creation.

(2) Research and Development

The OECD (2008) defines research and development (R&D) as "a creative work undertaken on a systematic basis in order to increase the stock of knowledge, including knowledge of man, culture and society, and the use of this stock of knowledge to devise new applications". Good outcomes from R&D can lead to the invention of new innovative products. Moreover, implementation of effective entrepreneurial leadership can also give a key predictor of the R&D success of an organisation. It is critical to stress the importance of entrepreneurial leadership capacity which can be demonstrated by the entrepreneur throughout all levels of an R&D organisation such as a high-technology firm. In R&D project teams, team leaders normally manage more educated and creative technical staff. They usually have more experience in handling technical rather than managerial tasks (Elkins & Keller 2003). This is the reason why these R&D managers need to acquire more leadership skills to demonstrate the leading role in the team. However, in uncertain conditions, R&D leaders with entrepreneurial leadership capacity who are able to demonstrate an effective and decisive combination of technical expertise, motivation of staff, strong team leadership and strategic business insight, will be highly sought after by other organisations.

Why are some entrepreneurs, who are better in identifying opportunities and decision-making, more successful than the other entrepreneurs? What kind of characteristics and information do these successful entrepreneurs have? According to Shane and Venkataraman (2000), two factors which can affect the entrepreneurs' behaviour and decision to discover and exploit opportunities are: the possession of the necessary information for opportunity identification, and the appropriate cognitive style for opportunity exploitation. Serial entrepreneurs have unique characteristics. These may be the reasons why some successful entrepreneurs are good at research and development for inventions than other entrepreneurs.

Entrepreneurs are found to use all three levels of intelligence, for example, intellectual, emotional and spiritual intelligence (La Pira & Gillin 2006). These three types of intelligence can impact entrepreneurial leadership in the entrepreneurial process.

Solving logical problems requires human intellectual intelligence (IQ). IQ tests are used by psychologists to find the level of intellectual intelligence of human beings. It is believed that the higher a person's IQ, the greater the individual propensity for solving complex logic problems. The nature of IQ is deterministic and linear (La Pira & Gillin 2006).

Although IQ is a useful tool to understand how smart an individual is, Goleman (1999) argued that the new measure called Emotional Intelligence (EQ) should be employed focusing on personal qualities such as empathy, initiative, adaptability and persuasiveness. In fact, Zohar and Marshall (2000) refer to it as associative thinking in their book *Spiritual Intelligence – The Ultimate Intelligence*. The simplest connection is that it is the link between our emotions and bodily feelings. EQ also enables the individuals to recognise learning skills and patterns.

With extensive studies done on intuition, there has been better understanding of the link between successful entrepreneurial behaviour and the propensity to use intuition in decision-making (La Pira & Gillin 2006). What is intuition? Why is it so important to the behaviour of entrepreneurs? In a simple term, intuition is the ability of an individual to access their subconscious mind. Based on the current definition of intuition, it shows the very linear understandings of cognition in the processing of information which already exists in the data banks of the brain (La Pira & Gillin 2006).

Based on the work on intuition by Briggs-Myers and McCaulley (1985), it is defined as the "meanings, relationships and possibilities that go beyond information from the five senses". Because of this definition, La Pira & Gillin (2006) have described this type of intuition as Non-local Intuition. As quoted in Keller (1983), non-local intuition is "…the daily effort that comes from no deliberate intention or programme but straight from the heart". McCraty, Atkinson and Bradley (2004) have recently opined that the heart appears to receive intuitive information before the brain. That intuition is not confined to cognitive-based perception but it involves the entire electrophysiological system, which manifests through a wide range of emotional feelings and physiological changes.

In summarising the research and development section, it is very important to understand and study the role of intuition for entrepreneurial leaders because these leaders have high propensity for using cognitive and non-local intuition with rational analysis in decision-making and intentional actions.

(3) Knowledge management

Knowledge can be divided into two major types, explicit or tacit knowledge (Dalkir 2005). Explicit knowledge includes tangible forms such as words, images or audio recordings which can be captured and codified to be transferred from one person to another. However, tacit knowledge is more difficult to express into words, drawings or text because its development is based on action, feeling and experience which can only be shared through direct interactions. With the significant role of tacit knowledge for innovation, firms can absorb and utilise this knowledge through the creation of new knowledge which can translate into superior goods and services for customers (Lu, Tsang & Peng 2008). Although knowledge is considered as a valuable commodity or an intellectual asset, there is a common saying that knowledge is "power" which can provide the competitive edge to the organisation (Bencsik & Bognár 2007).

Knowledge management (KM) is defined as

> "the deliberate and systematic coordination of an organisation's people, technology, processes, and organisational structure in order to add value through reuse and innovation. This value is achieved through the promotion of creating, sharing, and applying knowledge as well through the feeding of valuable lessons learned and best practices into corporate memory in order to foster continued organisational learning" (Dalkir 2005).

It is not just important for high-technology firms to possess the knowledge, they need also to have the capabilities of managing the knowledge that comes from their intellectual property such as copyright, patents or inventions (Hemlin 2006).

Darling, Gabrielsson and Seristo (2007) suggest that entrepreneurs who have the entrepreneurial management leadership will have the highest potential for success with the achievement of organisational excellence. It is also essential for the entrepreneurial management leadership to be exerted through successful contemporary entrepreneurship with a unique innovation and resource allocation to respond to a recognised opportunity (Darling, Gabrielsson & Seristo 2007). Besides, the leadership style can also make the difference in creating the appropriate climate for entrepreneurship and innovation in an organisation (Bhattacharyya 2006).

In summary, the entrepreneur with the entrepreneurial leadership capacity can speed up the entrepreneurial opportunity exploitation in high-technology ventures. Knowledge management should be carefully implemented throughout the entrepreneurial process.

Entrepreneurial Leadership Capacity

In simple terms, capacity is defined as "specific ability of an entity (person or organisation) or resource, measured in quantity and level of quality, over an extended period" (Definition of capacity 2012). In fact, capacity has similar meaning to capability and ability. Sometimes these three words are interchangeable in the expression.

Capability can simply be defined as "general measure of the ability of an entity (department, organisation, person, system) to achieve its objectives, especially in relation to its overall mission" (Definition of capability 2012). On the other hand, ability is named as "an acquired or natural capacity or talent that enables an individual to perform a particular job or task successfully" (Definition of ability 2012).

According to Weiss and Molinaro (2005, p. 5), leadership capacity is defined as "the extent to which organisations can optimise their current and future leadership to drive business results and successfully meet the challenges and opportunities of an ever-changing business environment."

The leadership gap refers to "the shortfall between the required leadership capacity and the current and forecasted leadership capacity which is preventing organisations from effectively building the leadership capacity they need to succeed in changing business environments" (Weiss & Molinaro 2005, p. 5). From these studies (Street et al. 2010, 2011; Barney & Arikan 2001; Leavy 1996), many senior human resource professionals link the effectiveness of responding to the business challenges to the strength of the leadership capacity that exists in their organisations. Besides, they also recognise that traditional strategies to build leadership capacity are inadequate to address the leadership gap that exists in most organisations. However, there are still many business executives who do not recognise the potential of leadership as a business driver and the strategic imperative of bridging the leadership gap. This short-sighted perspective causes a lot of failure in organisations. Leadership capacity and bridging the leadership gap will be critical in a new and fast-changing business environment (Weiss & Molinaro 2005, p. 6). This demonstrates the importance of using leadership capacity as the tool for building an organisation's competitive advantage which can bridge the leadership gap found in various businesses. Although entrepreneurial leadership refers to the intersection of the characteristics of "entrepreneurship" and "leadership", the concept, theory and critical role of entrepreneurial leadership remains insignificant for further research in the field of entrepreneurship. Despite attempts to link entrepreneurship and leadership for further research (Swiercz & Lydon 2002; Gupta et al. 2004; Darling, Keeffe & Ross 2007; Darling & Beebe 2007), entrepreneurship researchers are still not keen or do not know how to link these two disciplines for successful venture growth.

From the gaps in the literature, the researchers miss out the significance of building the concept of entrepreneurial leadership capacity in the venture growth. The author would like to propose this new framework of entrepreneurial leadership capacity (ELC) which can link leadership and entrepreneurship. ELC can link the entrepreneurs, external and internal drivers, and entrepreneurial process for venture growth by demonstrating the good characteristics of entrepreneurial leadership (See Figure 1.1).

By combining the definitions of leadership capacity and entrepreneurial leadership, the author has come up with this definition of ELC:

> "the extent to which, in an ever-changing business environment, the entrepreneurs/organisations can optimise their current and future leadership ability for anticipation, envision, flexibility, creative and strategic thinking, research and development for appropriate innovative inventions, recognition of innovation barriers, knowledge management, entrepreneurial activities for venture creation and initiation for collaborative change with sustainable business results and successful attainment of challenges and opportunities for a viable future for the organisation."

ELC is a new term in entrepreneurship research. Measuring instruments for determining entrepreneurial leadership capacity have not yet been developed previously. This proposed conceptual model will further develop what the literature has known about leadership capacity and develop it into a new model of entrepreneurship incorporating the entrepreneurial leadership capacity.

Entrepreneurs who have acquired the appropriate skill, behaviour and style of entrepreneurial leadership in the process of venture growth are called entrepreneurial leaders (Gupta et al. 2004). Entrepreneurial leaders who have the entrepreneurial leadership capacity are the ones who shape the organisation in venture growth and who also inspire the employees to deliver value to customers. However, some entrepreneurs may not know how to explore their entrepreneurial leadership capacity to the extent of optimising their current and future leadership to drive venture growth and to successfully meet the challenges and opportunities of an ever-changing business environment. The success as an organisation, in this case, is based on the ability to continually build its entrepreneurial leadership capacity.

There has been a misconception that the founding entrepreneurial leader should be replaced by a professional manager because of the perception that a founder may lack essential leadership skills and experience to grow the start-up into an ongoing enterprise (Swiercz & Lydon 2002). Because of this, even successful entrepreneurs should be highly recommended to transform themselves into successful professional managers with entrepreneurial leadership capacity, in particular as managers of growth-driven high-technology firms. It is very obvious that entrepreneurial leaders are capable of exploring their environments, identifying opportunities for exploitation and motivating participants actively in the process of value creation for entrepreneurship. If the entrepreneurs do have the entrepreneurial leadership capacity, they can provide the competitive advantages for their ventures which their competitors will find hard to follow and imitate (Kuratko & Hodgetts 2007).

3.2.4 The Entrepreneurial Process

The concept of entrepreneurship is very complex and various schools of thought or theories have been suggested (Cunningham & Lischeron 1991). Among these concepts, the entrepreneurial process has been widely accepted by most scholars as fundamental to entrepreneurship studies (Jack & Anderson 2002; Brockner, Higgins & Low 2004). Baron and Shane (2005) refer to entrepreneurship as a process that takes place in distinct but closely interrelated phases over time for venture growth. The entrepreneurial process is considered to be the inclusion of all the functions, activities and actions in perceiving opportunities and creating organisations in the pursuit of profit (Bygrave & Zacharakis 2008). The process approach breaks down entrepreneurial events into specific steps or stages, which are easier to analyse systematically and become more manageable for anyone to pursue or apply in the venture stages of all organisations.

The entrepreneurial process for venture growth involves these three stages: opportunity discovery, evaluation and exploitation (Shane & Venkataraman 2000). In the proposed model, the five entrepreneurial steps are: presence of opportunity; opportunity recognition; decision for opportunity exploitation; resource acquisition and process management. All five entrepreneurial steps are classified into these three entrepreneurial process stages. It is not the intention here to provide detailed reviews of each entrepreneurial step but merely brief descriptions for discussion.

(1) Opportunity discovery

<u>Presence of opportunity</u>

In the discovery stage, the presence of entrepreneurial opportunity occurs when there are changes in technology, economic, political, regulatory, demographic, or social conditions (Ardichvili, Cardozo & Ray 2003). The other reasons why some people can discover opportunities easier than others are better access to information about the existence of the opportunity due to their previous life experience, social network structure and information search, and better personal capability with absorptive capacity and cognitive processes given the same amount of information (Kirzner 1997). These opportunities may be discovered in the form of new products and services, but may also be new raw materials, new methods of production, new market and new approaches of organising as suggested by Shane (2003).

(2) Opportunity evaluation

Opportunity recognition

On the opportunity evaluation stage, opportunity recognition plays a critical step in the entrepreneurial process for venture growth. Opportunity recognition can be evaluated as an individual's enhanced capability for identifying the potentially valuable opportunity to create something new with the economic value of future profits (Baron & Shane 2005). The most important abilities of a successful entrepreneur are identifying and deciding on the right opportunities for exploitation with value creation for stakeholders in prospective business ventures (Stevenson, Roberts & Grousbeck 1985). Greater access to opportunity-related information can be enhanced by jobs with "cutting edge" information (Sternberg 2004), various life and work experience (Blanchflower & Oswald 1998), possession of a large social network (Fuller & Warren 2006) and possession of a schema of entrepreneurial alertness for an active search for opportunities (Gaglio & Katz 2001). Despite the greater access to information, some entrepreneurs have superior utilisation of opportunity-related information by having richer and more integrated stores of knowledge (Groen 2005) and higher practical intelligence (Hmieleski & Corbett 2006).

(3) Opportunity exploitation

In the stage of opportunity exploitation, the entrepreneurial process steps are decision for opportunity exploitation, assembling the required resources (e.g. information, financial and people) and the process management of the entrepreneurial process.

The entrepreneurs who have a better chance to exploit the opportunities will depend on the degree of the gap difference between the low or high opportunity cost and alternative uses of time (Shane 2003). The gap difference can be increased by the following factors: the availability of information and skills from high level of education and career experience; having a working spouse for uncertainty reduction and; mature and middle age with strong social position of accumulated wealth of information (Shane 2003). Various modes of exploitation depend on the nature of the organisation in that industry, the opportunity and the individual entrepreneur difference (Shane & Venkataraman 2000; Shane 2003).

<u>A. Industry context of the mode of entrepreneurial exploitation</u>

The industrial context of the mode of entrepreneurial exploitation for venture growth depends on five perspectives: knowledge conditions, demand conditions, industry life cycles, appropriability regime and industry structure (Shane 2003). Knowledge conditions can affect the level of entrepreneurial opportunity present in the industry. The favourable knowledge conditions are the high research and development intensity, the extra-value chain sources for the locus of innovation, high level for the size of the innovative entities and less uncertainty of the industry conditions.

Industry life cycles look at the mode of exploitation by including industry age, dominant design and presence of a density of firms. It is very common to have start-up firms which are younger, not conformed to a dominant design and existing in an appropriate density according to the sustainability of industry life cycle (Shane 2003).

According to Cohen and Levin (1989), the appropriability regime discovers that the form of entrepreneurial opportunity exploitation will be *de novo* start-ups when the intellectual property laws cannot protect the information and inhibit the sale of entrepreneurial opportunities. Therefore, the appropriability conditions include the strength of patents and importance of complementary assets for appropriating the returns to innovation. It is very common for the start-up formation paying more attention to patents and less attention to complementary assets in manufacturing, distribution and marketing in appropriating the returns to innovation (Shane 2003).

Industry structure, which is the set of characteristics affecting the long-term competitive advantages, includes the profitability of the industry, costs of inputs, capital intensity of the industry, industry concentration and average firm size. It is very favourable for entrepreneurs to exploit the entrepreneurial opportunities when the industries have higher profitability, are less advertising and capital intensive, are less concentrated, have lower average firm size and have lower cost inputs (Shane 2003).

To sum up the industry context of the mode of entrepreneurial exploitation, the entrepreneurs are more likely to start a business when the industries have low barriers to entry for competition (Acs & Audretsch 1987).

B. Nature of the opportunity

It is critical to understand the characteristics of opportunities that will affect the willingness of exploitation by the entrepreneurs. The expected value of entrepreneurial profit has to be large enough for the entrepreneurs to pursue in order to compensate for the opportunity cost of other alternatives and bearing the uncertainty (Kirzner 1973; Schumpeter 1934). Therefore, the type of opportunity plays a role in the mode of exploitation. When the nature of the opportunity is uncertain and cannot provide the chance to destroy the competition, entrepreneurs are less likely to start a new venture and will prefer to stick with the exploitation of the opportunities present in an existing firm in which that they are working (Casson 2003).

C. Individual difference

Not all potential entrepreneurs will pursue opportunity exploitation. The crucial part of the decision lies in the ease and the costs for obtaining the resources necessary for the opportunity exploitation. Past research has shown that individuals are less likely to start businesses when it is difficult to secure financing (Cohen & Levin 1989). Starting a business is more favourable when individuals lack incentives to do so in existing organisations and existing firms do not provide advantages to do so (Cohen & Levin 1989).

In summary for the modes of opportunity exploitation in this section, this new model will propose that entrepreneurs with the availability of information and entrepreneurial leadership capacity will have a higher chance to recognise the entrepreneurial opportunities for high-technology ventures with the understanding of the organisation nature in that industry, the opportunity and the individual entrepreneur difference. The entrepreneurial leadership capacity acts as the mediator between the entrepreneurial types (PA, SS, EI and RM) and the modes of opportunity exploitation in the entrepreneurial process for high-technology ventures.

Decision for opportunity exploitation

How do entrepreneurs decide to exploit the recognised opportunities? Researchers have indicated the significance of expected value from opportunity exploitation as an important issue. Relevant non-psychological factors include opportunity cost (Amit, Muller & Cockburn 1995), source of financial capital (Evans & Leighton 1989), career experience (Carroll & Mosakowski 1987), education, age and social position (Jones-Evans 1996). In addition, the psychological factors are also critical. Besides the three broad categories of psychological factors: aspect of personality and motives (e.g. extraversion, agreeableness, need for achievement, risk taking and desire for independence); core self-evaluation (e.g. locus of control, self-efficacy) and cognitive properties (e.g. overconfidence, representativeness and intuition) (Shane 2003), consideration of the motivations of people can influence the entrepreneurial decisions for opportunity exploitation (Shane, Locke & Collins 2003). Individual differences in motivation can vary the willingness and ability of others to make decisions for exploiting the opportunities in the entrepreneurial process.

The entrepreneurs with entrepreneurial leadership capacity can access the information and skills for enhancing the decision for opportunity exploitation. These entrepreneurial leaders who have the capability of creativity and innovation for researching and developing of new products and services through knowledge management for intellectual protection can have the highest chance in successful opportunity exploitation.

Resource acquisition

After deciding on opportunity exploitation, resource acquisition is the next step in the entrepreneurial process. Both financial and non-financial resources are required to pursue successful entrepreneurship. A lot of emphasis is placed on obtaining sufficient financial capital for business launching. Since capital can provide a buffer for withstanding adverse situations, the more capital the new venture can obtain the more likely it is to grow and survive with profits. However, there are still a lot of cases of failure even when entrepreneurs have sufficient financing. This brings into play the importance of acquiring the appropriate non-financial resources such as the information about markets, environmental and legal issues; human resources for hiring the right kind of employees with skills, knowledge, motivation and drive for success. There are six groups of resources: physical (e.g. buildings, equipment), financial (e.g. cash, debt capacity), organisational (e.g. structures, processes, systems), relational (e.g. customers, distributors, networks), technological (e.g. patents, licences, access to particular technologies) and intellectual and human (e.g. sales capabilities, R&D skills) (Morris et al. 2001). As a viable company, preparing a formal business plan as part of resources strategy can help the entrepreneur obtain financial support from investors and formulate specific goals and appropriate strategies.

Process management

Process management consists of the activities of planning and monitoring the performance of a process; and the application of techniques, skills, knowledge, tools and system for process improvement by meeting the goals of customer requirement with delivering benefits. With process management in place the business activities are planned, designed and performed, employees will work towards the alignment of its activity goal with the overall customer-oriented organisational goals. Process management can ensure a process with explicit goals which guide the employees to perform consistently and managers to improve it in a disciplined way. Process management engages the organising activities for the exploitation of entrepreneurial opportunities in the process. These organising activities include the creation and design of organisation, planning the modes of exploitation (e.g. spin-off, independent start-up, corporate venturing and acquisition/licensing) (Shane 2003). In order to exploit the recognised opportunity for which the resources have been assembled, the entrepreneur has to implement process management to ensure the smoothness or the effectiveness of the entrepreneurial process.

In summary, with the mediating role of entrepreneurial leadership capacity, entrepreneurial types (personal achiever (PA), super sales people (SS), expert idea generator (EI) and real manager (RM)) will be more likely to pursue modes of entrepreneurial opportunity exploitation in high-technology ventures. The entrepreneurial process starts with the presence of opportunities which need to be recognised by the entrepreneurs. Creative ideas will be developed and the decision has to be made how to exploit the opportunity with the acquired resources by developing the product or service. Design of start-up company and good business concepts with appropriate business models need to be developed to exploit the identified opportunity under the monitoring of entrepreneurial process management in order to achieve satisfactory enterprise performance.

3.2.5 Enhanced Organisational Achievement

It is important to emphasise the significant symbolic value of a good business concept to the company such as a competitive edge, the company's vision and organisational identity (Alvesson 1998). The business concept may be seen as the total value package that a company can offer with a combination of resources, for example, an improved or new product, process or service, new organisational structure and penetration of a new market segment (Morris et al. 2001). In simplest terms, the business concept represents a harmony between the organisation, the product and the market which lays the foundation for the future of the business. With good business concept, the entrepreneurs with entrepreneurial leadership capacity can pursue the entrepreneurial process successfully with the outcome of enhanced organisational achievement. In this new model of EELC, business models and enterprise performance will be studied as the enhanced organisational achievement in high-technology industry.

Business models

There are three perspectives of business model: economic, operational, and strategic, each with its unique set of decision variables (Morris, Schindehutte & Allen 2005). However, the strategic perspective is the most important.

In the economic perspective which focuses on profit generation, a business model is described as "a statement of how a firm will make money and sustain its profit stream over time" (Stewart & Zhao 2000). The relevant decision variables are revenue sources, pricing methodologies, cost structures, margins, and expected volumes. The operational business model concentrates on internal processes and the design of infrastructure for value creation. Decision variables are administrative processes, knowledge management, production or service delivery methods, resource flows and logistical streams (Morris et al. 2005). From the strategic perspective, a business model is defined as "a strategic design for how a company intends to profit from its broad array of strategies, process and activities" (Robbins & Coulter 2005). Decision elements comprise vision, values, stakeholder identification, value creation, differentiation, networks and alliances. The integrative definition is adopted as "a business model is a concise representation of how an interrelated set of decision variables in the areas of venture strategy, architecture, and economics are addressed to create sustainable competitive advantage in defined markets" (Morris et al. 2005).

In this new model, the following business models are being considered which are often implemented by high-technology industry: strategic alliance with partners, refocussed current product development, launching of new products, raised public capital, raised private capital, and mergers and acquisition (Morris et al. 2005).

In summary, the entrepreneur with the entrepreneurial leadership capacity will influence the modes of opportunity exploitation with appropriate business models as the enhanced organisational achievement in high-technology ventures.

Enterprise performance

Every organisation needs to manage, measure and improve its business performance in order to maintain its survival and competitive edge. Business performance is also used to measure the effectiveness of entrepreneurs in running the company (Covin & Slevin 1991). Business performance is comprised of two components: market performance and financial performance (Nakata, Zhu & Kraimer 2008). In market performance, market share, customer retention, customer value and product quality are measured as the relative effectiveness of an organisation in market domains. On the other hand, return on equity, investment and gross profits reflect the relative effectiveness of an organisation in financial performance domains. Five specific areas of business performance are described as financial performance, innovation capability, competition performance, supply chain relationships and manufacturing capability (Tseng, Chiu & Chen 2009).

In this new model of entrepreneurship, the enterprise performance is being measured in these seventeen areas: managerial skills, efficiency/speed of product development, skilled labour, quality of product, marketing capability, collaboration with universities/research centres, government support, collaboration with industrial companies, access to seed/venture capital, collaboration with other companies, access to domestic markets, physical proximity to collaborators, access to international markets, ability to recognise commercial application of technology, learning from end users, technology transfer from suppliers/ inventors and research capability (Hall & Bagchi-Sen 2002).

In summary, the entrepreneur with the entrepreneurial leadership capacity will influence the modes of opportunity exploitation with satisfactory enterprise performance as the enhanced organisational achievement in high-technology ventures.

3.3 Needs and Benefits for a New Model of Entrepreneurship with Entrepreneurial Leadership Capacity (EELC) for High- Technology Ventures

Why do we need a new model of entrepreneurship? Are those prior models of entrepreneurship not suitable for high-technology ventures? In the literature, extensive themes or topics for entrepreneurship research have been proposed and studied for more solid theory building (Ucbasaran, Westhead & Wright 2001; Busenitz, West III, Shepherd, Nelson, Chandler & Zacharakis 2003). Gregoire, Noel, Dery and Bechard (2006) classify seven major convergence areas in entrepreneurship research in the following groups: identification and exploitation of opportunities (Kirzner 1973, 1997; Ardichvili, Cardozo & Ray 2003; Short, Ketchen, Shook & Ireland 2010), characteristics of individual entrepreneur

(Hornaday 1971; Gartner 1989; Littunen 2000), dynamics of the emerging venture (Schumpeter 1943; Barney 1991; Barney, Wright & Ketchen Jr 2001), behaviours of firms (Schumpeter 1934; Lumpkin & Dess 1996), factors influencing the dynamics of new venture performance (Sandberg & Hoffer 1987), venture capital (MacMillan, Siegel & Narasimha 1985; MacMillan, Zemann & Subbanarasimha 1987; Butler, Lockett & Ucbasaran 2006) and social capital and social network (Birley 1985; Watson 2007; Slotte-Kock & Coviello 2010).

Although the seven conceptual convergence areas in entrepreneurship research have provided a good approach for further building entrepreneurship theory, there is still strong demand for searching for a distinctive theory of entrepreneurship and a better conceptual framework development (Shane & Venkataraman 2000; Morris et al. 2001; Phan 2004). Increasingly, researchers admit that entrepreneurship is an eclectic phenomenon. Because of this, entrepreneurship scholars should draw from multiple disciplines, methods and theories, for example, economics, sociology, psychology, leadership, strategic management, anthropology and others for studying the questions related to individual-, firm-, and society-level effects of entrepreneurship (Ireland & Webb 2007a). In addition to cross-disciplinary collaborations, Phan (2004) has also suggested a holistic and co-evolutionary approach which will involve multilevel theories for investigating the emerging phenomenon, even at lower levels of analyses for finding additional knowledge about entrepreneurship.

This new model of entrepreneurship for high-technology ventures is developed from multiple disciplines, methods and theories, and takes an holistic and co-evolutionary approach, with some of the benefits presenting themselves as follows: determination of the characteristics of entrepreneur's type of personality; assessment of the intensity of entrepreneurial leadership by would-be founders and conducive to making investment decisions by venture capitalists during the screening process; the identification of key factors determining entrepreneurial success in the high-technology industry and the further development of theory building of entrepreneurship in high-technology entrepreneurship.

The entrepreneur with entrepreneurial leadership capacity (ELC) can achieve a successful and faster mode of opportunity exploitation in high-technology venture process and have satisfactory or better enterprise performance with appropriate business models after the start-ups are formed. However, the entrepreneurs without ELC are more likely not to pursue the opportunity exploitation or have a poor enterprise performance with inappropriate business models after the start-ups are formed. Even if these start-up firms are formed, they will still have a high failure rate in business, spending more time in the early stages. These high-technology firms will suffer from poor enterprise performance and less profit. Essentially, this EELC model suggests that the ELC may be a key determining factor for success of high-technology ventures. It is also shown that the entrepreneurs who have ELC can create the competitive advantages for a firm to achieve excellence, which competitors will find difficult to understand and imitate.

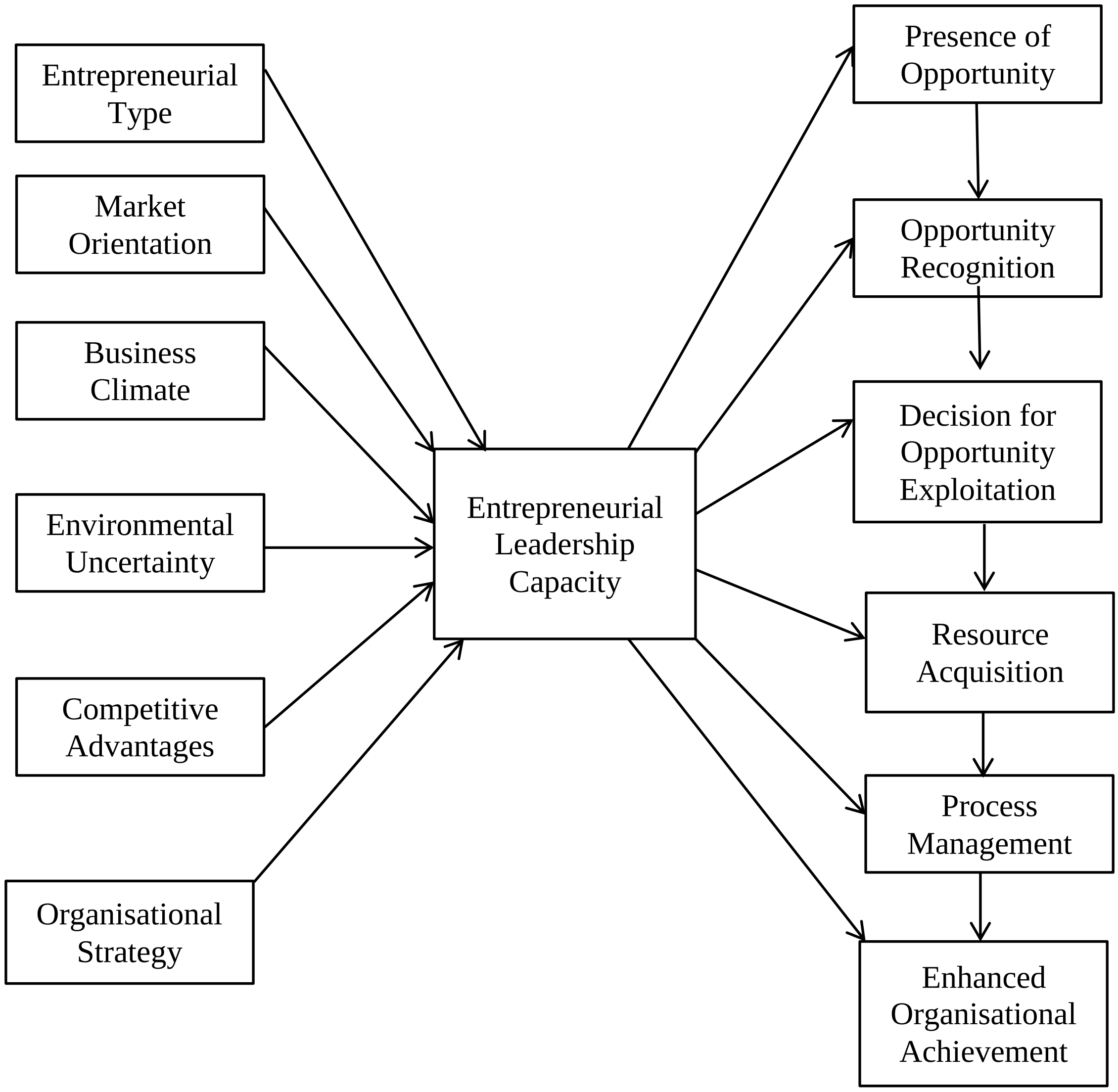
3.4 A New Model of Entrepreneurship with Entrepreneurial Leadership Capacity (EELC) for High-Technology Ventures

This new model of entrepreneurship (EELC), as shown in Figure 1.1, will provide an understanding of the process of venture growth in the high-technology industry. It describes how the following variables interact with each other in high-technology ventures: the entrepreneurial type (personal achiever (PA), super sales people (SS), expert idea generator (EI) and real manager (RM)), the external drivers (market orientation, business climate, environmental uncertainty and competitive advantages), the internal driver (organisational strategy), the entrepreneurial leadership capacity (types of innovation and; recognition of innovation barriers from financial, regulatory and resource perspectives), the entrepreneurial process (presence of opportunity, opportunity recognition, decision for opportunity exploitation, resource acquisition, process management) and the enhanced organisational achievement (business models and enterprise performance). This new model will predict that the entrepreneurs with ELC are more likely to successfully pursue modes of opportunity exploitation with good business models and enterprise performance for creating new start-up high-technology ventures. The modes of exploitation are based on the entrepreneur, as well as the ELC of the entrepreneur.

The uniqueness of this new model of entrepreneurship lies in the additional factor of ELC as the mediator in linking the variables (e.g. the entrepreneurial types, the external and internal drivers) in pursuing the modes of opportunity exploitation to the success of entrepreneurial start-up ventures. This EELC model makes a contribution to the building of entrepreneurship theory by providing a comprehensive framework to understand the relationship between leadership and entrepreneurship in all industries. Based on its common features and applicability, it is also suitable to be tested and applied in various types of ventures.

In future research, the biotechnology industry will be chosen as the focus field to verify this new model because of the strong demand for ELC in managing such a complex venture. The biotechnology industry fits all the requirements for testing this new model by demonstrating the significance of ELC as the mediator among the entrepreneurial types, the external drivers, the internal driver, the entrepreneurial leadership capacity, the entrepreneurial process and the enhanced organisational achievement.

Figure 1.1 A new model of entrepreneurship with entrepreneurial leadership capacity (EELC) for high-technology ventures



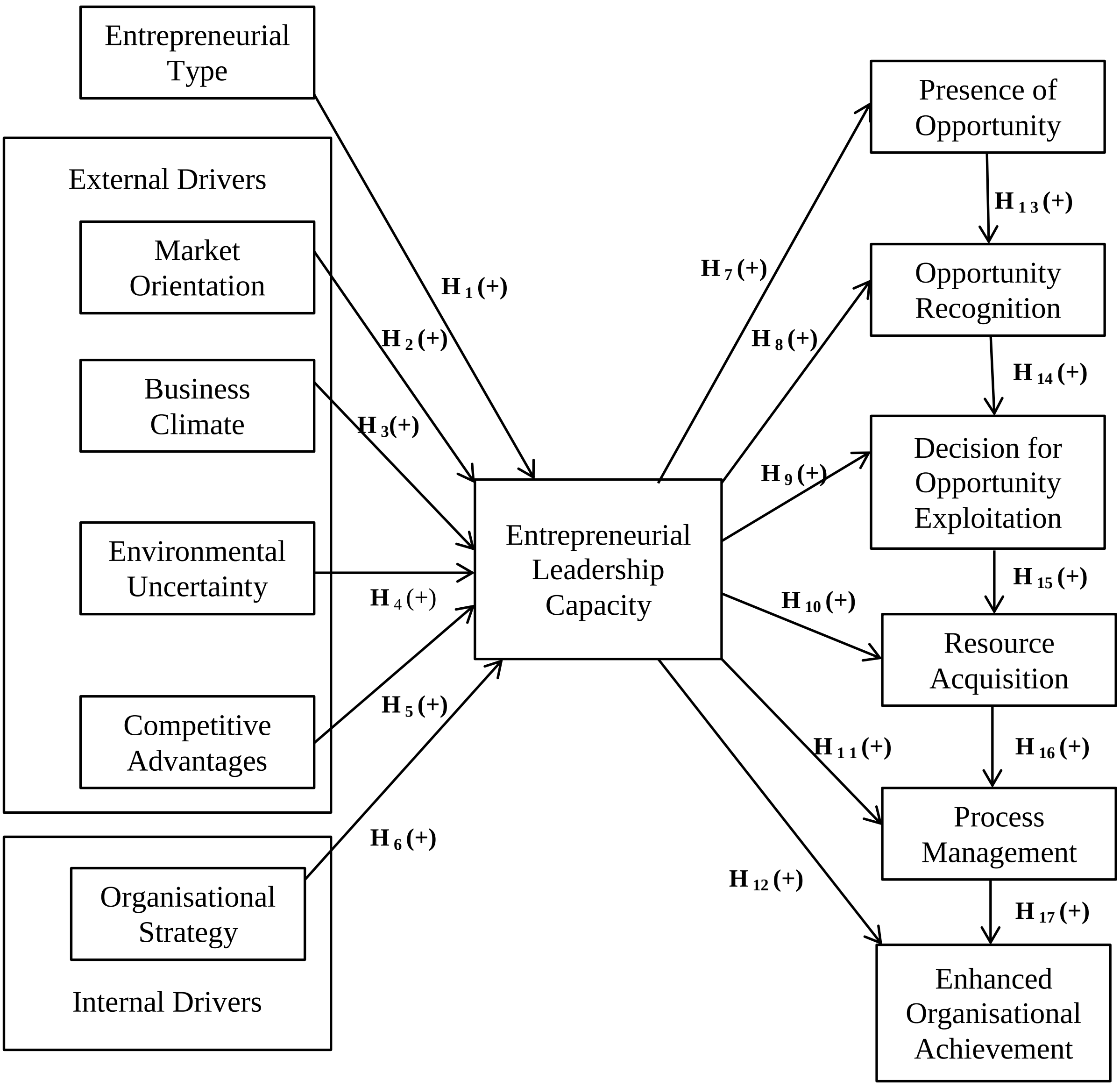
Source: Author's own compilation

In Chapters 4 and 5, the research data from the questionnaire survey will be discussed to test the validity of this new model. The outcome of this research will further contribute to the knowledge of theory building of entrepreneurship as a domain of "mature field" of discipline away from its infancy of research. This EELC model for venture growth will provide the new direction for entrepreneurship research.

3.4.1 Hypotheses for A New Model Of Entrepreneurship

Figure 3.2, which is derived from Figure 1.1, lists the thirteen variables and seventeen hypotheses that are proposed to test the validity of this new model of entrepreneurship. Figure 3.3 describes the research model with all the measurement instruments that are being considered in this study. Individual discussion of each hypothesis will be discussed in detail in the following sections.

Figure 3.2 Research model of entrepreneurship with entrepreneurial leadership capacity (EELC) for high-technology ventures



Source: Author's own compilation

Figure 3.3 Measurement Instruments for research model of entrepreneurship with entrepreneurial leadership capacity (EELC) for high-technology ventures

Entrepreneurial Type (ET) (Q24)
- Personal achiever
- Super' sales people
- Expert idea generator
- Real manager

Market Orientation (MO) (Q38)
-Identified customer needs
- Emerging industry
- High market growth rate (eg 30-50%)
- High gross margin (eg 40-50%)
- Reasonable market share (eg 20%)

Business Climate (BC) (Q39)
- Good profit after tax (eg 10-15%)
- Short time to break even and positive cash flow (eg under 2 years)
- Low to moderate capital requirements

Environmental Uncertainty (EU) (Q41)
- Political infrastructure in society
- Legal infrastructure
- Regulatory infrastructure
- Socio-cultural infrastructure
- Financial infrastructure

Competitive Advantages (CA) (Q40)
- Low fixed and variable costs for production/marketing/distribution
- Moderate to strong degree of control for prices/costs/channels of supply etc
- Barriers to entry for proprietary protection/lead time/legal advantage
- Product differentiation

Organisational Strategy (OO) (Q42)
- Logistical infrastructure
- Within-company infrastructure
- Networks/contacts
- Management team expertise
- Risk control

Entrepreneurial Leadership Capacity

Types of Innovation (TI) (Q28)
- New to the world product or service
- New to the firm product or service in line that at least one competitor is offering
- New to the country and/or market product or service
- New application of existing product or service, including application to a new market segment
- Addition to a company's existing product or service line
- Repositioning of an existing product or service
- Product/service improvement, revision, including application of new feature or option or change
- Process improvement for new administrative system or procedure
- Process improvement for new production method
- Process improvement for new marketing or sales approach
- Process improvement for new customer support program
- Process improvement for new logistical approach
- Process improvement for new pricing approach
- Process improvement for new distribution channel or method
- Process improvement for new financing method
- Process improvement for new purchasing technique
- Process improvement for new organisational form or structure

Recognition of innovation barriers (IB) (Q31)

Financial
- Lack of venture capital in early stage of venture
- Lack of public funds in early stage of venture
- Lack of government research funds in early stage of venture
- Lack of venture capital in late stage of venture
- Lack of public funds in late stage of venture
- Lack of government research funds in late stage of venture

Regulatory
- Australian government regulations (eg state or federal)
- Foreign government regulations (eg CE/EMEA approval etc)
- Australian patent process
- Foreign patent process
- TGA approval process
- FDA approval process

Resource
- Lack of skilled managers
- Lack of skilled researchers
- Lack of research facilities/assets
- Lack of manufacturing facilities
- Lack of marketing/distribution channels
- Lack of clinical trial facilities

Presence of Opportunity (PO) (Q23)
- In market (eg needs, customers and potential market size)
- In Economy (eg profits after tax and time to break even etc)
- In competitive advantage (eg barrier to entry, and degree of control over costs and prices etc)
- In network/management expertise/risk control

Opportunity Recognition (OR) (Q23)
- Changing demographics
- Emergence of new market segments
- New process needs
- New technologies
- Incongruities/ Lack of harmony
- Regulatory change
- Social change

Decision for Opportunity Exploitation (DOE) (Q23)
- New products
- New services
- New processes
- New markets
- New organisational structure/forms
- New technologies
- New sales or distribution channels

Resource Acquisition (RA) (Q23)
- Skilled employees
- General management expertise
- Marketing and sales expertise
- Technical expertise
- Financing
- Distribution
- Source of supply
- Production facilities
- Licences, patents and legal protection

Process Management (PM) (Q23)
- Absorption of new concept into mainstream operations
- Licensing of rights with other company
- Calculating the uncertainty of opportunities/risk
- Company organisation design

Enhanced Organisational Achievement

Business model (BM) (Q36)
- Strategic alliance with partners
- Refocussed current product development
- Launch new products
- Raised public capital
- Raised private capital
- Acquisition
- Merger

Enterprise performance (EP) (Q37)
- Managerial skills
- Efficiency/speed of product development
- Skilled labour
- Quality of product
- Marketing capability
- Collaboration with universities/research centres
- Government support
- Collaboration with industrial companies
- Access to seed/venture capital
- Collaboration with other biotechnology companies
- Access to domestic markets
- Physical proximity to collaborators
- Access to international markets
- Ability to recognize commercial application of technology
- Learning from end users
- Technology transfer from suppliers/ inventors
- Research capability

Source: Author's own compilation

3.4.1.1 Entrepreneurial Type

Entrepreneurs as leaders must lead in setting up the standard operating procedures or organisational structures when a company is created from scratch. Since entrepreneurs are different from corporate managers who often have more well-defined company goals, structures, and operational procedures to follow, questions have been raised about which forms of leadership behaviour are most effective for entrepreneurs to venture successfully through the stages of firm development (Vecchio 2003). Does any entrepreneurial type possess a distinctive entrepreneurial leadership capacity?

Therefore, the first hypothesis is as follows (Figure 3.2):

Hypothesis 1 (H_1)

The most appropriate entrepreneurial type is positively associated with entrepreneurial leadership capacity (ELC) in high-technology ventures.

Effective leadership plays a critical role in the success of achieving company's outcomes for various types and sizes of entrepreneurial firms (Daily, McDougall, Covin & Dalton 2002). Moreover, many entrepreneurs demonstrate a similar leadership ability/capacity that is close to their personality characteristics and environment is called entrepreneurial leadership. Consequently, a strong entrepreneurial leader can make an organisation become more entrepreneurial as a whole (Ribeiro & Comeche 2007). In Figure 3.3, any of the four types of entrepreneurs (personal achiever (PA), expert idea generator (EI), super sales people (SS) and real manager (RM)) may become a leader (Miner 2000, Morris et al. 2000) with entrepreneurial leadership capacity (ELC). The most appropriate entrepreneurial type is positively associated with ELC in high-technology ventures. Some entrepreneurial types will demonstrate more ELC than the other types. With ELC, the most appropriate entrepreneurial type can recognise the innovation barriers (financial, regulatory and resource barriers for innovation as shown in Figure 3.3) and promote the types of innovation (new to the world product or service; and new to the country and/or marketable product or service etc. as shown in Figure 3.3) for commercialisation that are needed in high-technology ventures (Hall & Bagchi-Sen 2002; Morris et al. 2000; Vitale 2004).

Essentially this new model suggests that the entrepreneurial leadership capacity would be a key determining factor for success in entrepreneurial start-ups. Because of its importance to the success of start-up venture, an ELC, which is the mediator, needs to be shown by different entrepreneurial types in order to pursue the modes of exploitation in the entrepreneurial process of new high-technology ventures.

3.4.1.2 Market Orientation

As one of the external drivers in this study, market orientation was initially defined as an organisation-level culture involving the values and beliefs of putting the customer first in business planning (Renko, Carsrud & Brännback 2009). In fact, as the concept develops further, market orientation has been approached both as an aspect of organisational culture and as a behavioural phenomenon (Day 1999; Slater & Narver 1999). Market orientation has characteristic as “the cyclic process of information acquisition about an organisation’s environment, the distribution and interpretation within the organisation of this intelligence, and the organisation’s responsive action” (Renko, Carsrud & Brännback 2009). Slater and Narver (1995) also comment that appropriate organisational processes coupled with an entrepreneurial spirit are necessary for an effective market orientation.

Therefore, the second hypothesis is in the following (Figure 3.2):

Hypothesis 2 (H_2)

Market orientation is positively associated with entrepreneurial leadership capacity (ELC) in high-technology ventures.

Entrepreneurs who work within high-risk levels are more likely to be market orientated (Harris & Ogbona 2001). High market orientation level reduces uncertainty in the business and therefore lowers the need for taking risks (Esteban, Millán, Molina & Martín-Consuegra 2002). Although low risk can be taken along with pro-activeness which is another capability of an entrepreneur to take calculated risks (Goleman 1998). Since small companies are more responsive and pro-active towards market orientation (Becherer, Halstead & Haynes 2001), it would therefore appear that proactive entrepreneurs could use market orientation as a mechanism to reduce risk. Besides, there is a definite relationship between corporate entrepreneurship and the components of the market orientation (Barrett & Weinstein 1998).

The second hypothesis proposes that market orientation is positively associated with entrepreneurial leadership capacity (ELC). Figure 3.3 lists the following instruments being measured in marketing orientation: identified customer needs; emerging industry; the high market growth rate (e.g. 30-50%); high gross margin (e.g. 40-50%); reasonable market share (e.g. 20%) (Morris et al. 2000; Barrett & Weinstein 1998). With ELC, the conditions in market orientation help recognise the innovation barriers and promote the type of innovation that is needed in high-technology ventures.

Matsuno, Mentzer, and Ozsomer (2002) suggest that the greater the level of entrepreneurial proclivity, the greater the level of market orientation. In this sense, organisations with higher levels of market orientation tend to place more emphasis on entrepreneurship (Matsuno et al. 2002). The adoption of entrepreneurship in organisations enables organisations to identify the latent needs of customers and innovative ways to address their existing needs. A primary entrepreneurial activity is not only to create better products than competitors but also to lead the industry in recognising customers' evolving needs (Slater & Narver 1995). Thus, an integrated market orientation with its focus on understanding both expressed and latent customer needs is inherently entrepreneurial (Slater & Narver 1995). Matsuno et al. (2002) suggest that entrepreneurship facilitates organisational members' willingness and ability to commit to market learning activities, to recognise the need to reduce uncertainty and take more calculated risk. This promotes a strong market orientation.

3.4.1.3 Business Climate

The business climate generally includes a very large number of factors, including levels of human capital, natural resource endowments, the size of domestic markets, infrastructure, administrative burdens, distance from foreign markets, the tax burden, the efficiency of civil administration, the incidence of corruption and the extent to which the rule of law applies (OECD 2011). Besides, business climate is also regarded as a catch-all variable for the local milieu for innovations and private investment which is basically accepted as a favourable key factor for local economic development (Blume 2006). At the same time, local economic policies can even lead to improvement of the local business climate such as community values and attitudes, business history, recruitment efforts and legislative policies.

An economy is said to have a sound business climate when it dwells on stability and openness in economic and political policies; efficient, transparent and effective governance and regulatory systems; and availability of the required infrastructure that supports economic activities to grow and thrive. A sound business climate encourages investments and entrepreneurship needed for growth and development (Mensah 2012). The author would like to propose the third hypothesis as follows (Figure 3.2):

Hypothesis 3 (H_3)

Business climate is positively associated with entrepreneurial leadership capacity (ELC) in high-technology ventures.

Although there have not been many researches done on the relationship between business climate and entrepreneurial leadership, the author would like to investigate the possibility of any relationship between business climate and entrepreneurial leadership capacity (ELC). In this third hypothesis, it is proposed that business climate is positively associated with ELC which will lead to the success of finding the presence of opportunity later in high-technology ventures. Figure 3.3 describes the following instruments being measured in business climate: good profit after tax (e.g. 10-15%); short time to break even and positive cash flow (e.g. under 2 years) and low to moderate capital requirements (Morris et al. 2000; Vitale 2004). With ELC, the business climate will provide favourable environment how to recognise the innovation barriers and commercialise the types of innovation that are needed in high-technology ventures.

3.4.1.4 Environmental Uncertainty

Environmental uncertainty indicates the sense of unpredictability and imperfect knowledge about the environment (Verdu, Tamayo & Ruiz-Moreno 2012). Besides, environmental uncertainty has also been defined as an inability to anticipate fast changes in economic conditions (Dess & Beard 1984; Krishnan et al. 2006). It has even been described as unpredictability or instability in the markets (Aldrich 1979) or technological fields (Moorman & Miner 1997) which requires significant scanning of the industrial condition in order to acquire accurate and reliable information. This will enable the new venture to interpret and act upon the risks and threats facing it (Krishnan et al. 2006).

Gartner and Liao (2007), and Liao and Gartner (2006) found that perceptions of environmental uncertainty played an important role in differentiating between nascent entrepreneurs who were more likely to engage in preventive planning, or not. Based on those findings, they surmised that differences in perceptions of environmental uncertainty would likely influence differences in risk perceptions among nascent entrepreneurs, as well (Gartner & Liao 2012). There is a relationship between environmental uncertainty and entrepreneurship. Therefore, the fourth hypothesis is as follows (Figure 3.2):

Hypothesis 4 (H_4)

Environmental uncertainty is positively associated with entrepreneurial leadership capacity (ELC) in high-technology ventures.

The fourth hypothesis proposes that environmental uncertainty is positively associated with ELC in high-technology ventures. In Figure 3.3, it lists the following instruments being measured in environmental uncertainty: political infrastructure in society, legal infrastructure, regulatory infrastructure, socio-cultural infrastructure and financial infrastructure (Morris et al. 2000; Spekman & Stern 1979). In the presence of ELC, the infrastructures in environmental uncertainty will provide situational information how to recognise the innovation barriers and commercialise the types of innovation that are needed in high-technology ventures.

Environmental uncertainty has a contingent value (Krishnan et al. 2006) and suggests that high innovative performance results from the fit between the strategic posture of the new venture and the environmental factor. In addition, environmental uncertainty plays an important role in the choice of supply chain strategy which influences the development of both competitive and supply chain strategies.

3.4.1.5 Competitive Advantages

Generally, competitive advantage indicates that an enterprise can earn more business performance than its competitors in the same industrial area by utilising its assets and/or competencies. In fact, competitive advantage explains their positioning theories of competitive strategy structure, and uses “five forces” to analyse the competitive advantage of an industry (Porter 1985). An enterprise ought to choose a proper industrial position, to make its competitive pressure lighter, or to adopt some actions on its rival firms to earn its own benefits (Porter 1985). Firms can enhance their chances for survival, growth, competitiveness and profitability by implementing strategies to gain competitive advantage.

Entrepreneurship has been praised as the engine for firm creation and economic growth. Any decision-maker who can boldly and actively deal with problems can learn to become an entrepreneur. Entrepreneurs can take the changes in environment as normal situations and try to utilise the opportunities in environments. The risks of starting a business mainly come from that only a few persons have the idea and the spirit of entrepreneurship. Entrepreneurs can find the source of innovation, the changes of environment, and clue of opportunity in environment, and can understand the principle of successful innovation and use it.

Entrepreneurship is an important influencing factor for sustained competitive advantage. Therefore, the fifth hypothesis is as follows (Figure 3.2):

Hypothesis 5 (H_5)

Competitive advantages are positively associated with entrepreneurial leadership capacity (ELC) to successfully find the presence of opportunity in high-technology ventures.

The fifth hypothesis proposes that competitive advantage is positively associated with ELC in high-technology ventures. Figure 3.3 states the following instruments being measured in competitive advantage: low fixed and variable costs for production/ marketing/distribution, moderate to strong degree of control for prices/costs/ channels of supply etc., barriers to entry for proprietary protection/lead time/legal advantage and product differentiation (Morris et al. 2000). In the presence of ELC, the competitive advantage will provide the favourable ground for the organisations or entrepreneurs to compete so that they can recognise the innovation barriers and commercialise the types of innovation required in high-technology ventures. ELC will permeate the strategies of the company which becomes the source of competitive advantage for sustainability in the dynamic business world.

3.4.1.6 Organisational Strategy

Organisational strategy can be defined as a plan for interacting with the competitive environments to achieve organisational goals (Daft, 1995, p. 49). It is designed to give a firm a competitive edge over its rivals in the same industry.

Leadership development is an organisational strategy for meeting the challenges of ever-increasing high-technology and global environment (Reichard & Johnson 2011). This illustrates that there is a relationship between organisational strategy and leadership development. This leads to the proposal of the sixth hypothesis, as follows (Figure 3.2):

<u>Hypothesis 6 (H_6)</u>

Organisational strategy is positively associated with entrepreneurial leadership capacity (ELC) in high-technology ventures.

The sixth hypothesis proposes that organisational strategy is positively associated with ELC in high-technology ventures. In Figure 3.3, it lists the following instruments being measured in organisational strategy, logistical infrastructure, within-company infrastructure, networks/contacts, management team expertise and risk control (Morris et al. 2000; Hall & Bagchi-Sen 2002).

With ELC, the organisational strategy will provide the appropriate strategy to recognise the innovation barriers and commercialise the types of innovation that are needed in high-technology ventures.

3.4.1.7 Relationship of Entrepreneurial Leadership Capacity and Entrepreneurial Process

The chain process model of creativity, innovation and entrepreneurship can also be used to explain the role of ELC as the mediator between entrepreneurial types and modes of exploitation in the entrepreneurial process (Schaper & Volery 2007). Creativity and innovation are the two main factors influencing the entrepreneurial process (Schaper & Volery 2007). Creativity is the root of innovation. At the centre of the model, innovation represents the company's capabilities and its linkages both from the marketplace (market pull) and the science base (technology push). One source of opportunity for developing and commercialising new products or new services (pull factors) is from the unsatisfied needs in the marketplace. Knowledge is transferred over a complex set of communication paths in the overall process. Idea generation (creativity), ideas evaluation (innovation) and ideas implementation (entrepreneurship) are the successive stages which are being distinct and separate in this chain process model. These stages can overlap and entrepreneurship is not necessarily a linear process. The implication of this chain process model suggests that creativity and innovation are the first stages of successful entrepreneurial initiatives. The major characteristic of the entrepreneur is the generation of a new or innovative idea that can be of commercial value.

However, in Schumpeter's (1934) theory, an act of will is required for successful innovation, but not of intellect. This act of will is referring to leadership which is very similar to creativity in the chain process model. It demonstrates that innovation depends, therefore, on leadership, not intelligence. From this it implies that leadership can lead to innovation and innovation leads to entrepreneurship. In deduction, leadership can lead to entrepreneurship. This also illustrates very clearly that entrepreneurial leadership has an influencing or mediating role between entrepreneurial types and modes of exploitation in the entrepreneurial process.

From the literature review, there are not many researchers studying the relationship between leadership and the entrepreneurial process. The aim of this EELC model intends to explore this relationship. What role does entrepreneurial leadership capacity play between the independent variables and the dependent variables in high-technology ventures?

1. Presence of Opportunity

The presence of entrepreneurial opportunity occurs when there are changes in technology, economic, political, regulatory, demographic, or social conditions

(Ardichvili, Cardozo & Ray 2003). The other reasons why some people can discover opportunities easier than others are better access to information about the existence of the opportunity due to their previous life experience, social network structure and information search; and better personal capability with absorptive capacity and cognitive processes given the same amount of information (Kirzner 1997). Are there any differences for those entrepreneurs who can find the presence of opportunity easily? Therefore, the seventh hypothesis is as follows (Figure 3.2):

> **Hypothesis 7 (H_7)**
>
> *Successful deployment of entrepreneurial leadership capacity (ELC) is more likely to find the presence of opportunity in high-technology ventures.*

Figure 3.3 lists the following instruments being measured in the presence of opportunity: in market (needs, customers and potential market size); in economy (profits after tax and time to break even etc.); in competitive advantage (barrier to entry, and degree of control over costs and prices etc); in network/management expertise/risk control (Morris et al. 2000; Shane 2003). With the recognition of innovation barriers and the types of innovation in ELC, the entrepreneurs will have the ability to find the presence of opportunities easier than others who do not have better access to information about the existence of the opportunity.

2. Opportunity Recognition

The entrepreneurs who have a better chance to exploit the opportunities will depend on the degree of the gap difference between the low or high opportunity cost and alternative uses of time (Shane 2003). Various modes of exploitation depend on the nature of the organisation in that industry, the opportunity and the individual entrepreneur difference (Shane & Venkataraman 2000; Shane 2003). How can some entrepreneurs recognise the opportunity more easily than the others? Therefore, the eighth hypothesis is as follows (Figure 3.2):

Hypothesis 8 (H_8)

Successful deployment of entrepreneurial leadership capacity (ELC) is more likely to recognise the opportunity in high-technology ventures.

Figure 3.3 describes the following instruments being measured in opportunity recognition: changing demographics, emergence of new market segments, new process needs, new technologies, incongruities/lack of harmony, regulatory change and social change (Morris et al. 2000; Shane 2003). With the recognition of innovation barriers and the types of innovation in ELC, the entrepreneurs will have the ability to recognise opportunities easier than others who do not have better access to information about the opportunity.

This EELC proposes that entrepreneurs with the availability of information and ELC will have a higher chance to recognise the entrepreneurial opportunities for high-technology ventures. The entrepreneurial leadership capacity acts as the mediator between the entrepreneurial types (PA, SS, EI and RM) and the modes of opportunity exploitation in the entrepreneurial process for high-technology ventures.

3. Decision for Opportunity Exploitation

How do entrepreneurs decide to exploit the recognised opportunities? Among the psychological factors of aspects of personality and motives, core self-evaluation and cognitive properties (Shane 2003), consideration of the motivations of people has the significance of influencing the entrepreneurial decisions for opportunity exploitation (Shane, Locke & Collins 2003). Individual differences in motivation can vary the willingness and ability of others to make decisions for exploiting the opportunities in the entrepreneurial process.

How can some entrepreneurs make the decision easier and faster for opportunity exploitation? Therefore. the ninth hypothesis is as follows (Figure 3.2):

Hypothesis 9 (H_9)

Successful deployment of entrepreneurial leadership capacity (ELC) is more likely to decide for opportunity exploitation in high-technology ventures.

In Figure 3.3, it discusses the following instruments being measured in decision for opportunity exploitation: new products, new services, new processes, new markets, new organisational structure/forms, new technologies and new sales or distribution channels (Morris et al. 2000; Shane 2003). With the recognition of innovation barriers and the types of innovation in ELC, the entrepreneurs will have the ability to make the decision easier and faster for opportunity exploitation in high-technology ventures.

The entrepreneurs with entrepreneurial leadership capacity can access to the information and skills for enhancing the decision for opportunity exploitation. These entrepreneurial leaders who have the capability of creativity and innovation for researching and developing of new products and services through knowledge management for intellectual protection can have the highest chance in successful opportunity exploitation. The ELC has a critical role as the moderator between the entrepreneur type (PA, SS, EI and RM) and the modes of opportunity exploitation in the entrepreneurial process for high-technology ventures.

4. Resource Acquisition

Both financial and non-financial resources are required to pursue successful entrepreneurship. A lot of emphasis is placed on obtaining sufficient financial capital for business launching. However, there are still a lot of cases of failure even when entrepreneurs have sufficient financing. Non-financial resources such as the information about markets, environmental and legal issues; human resources for hiring the right kind of employees with skills, knowledge, motivation and drive for success are also very important.

How can some entrepreneurs acquire the resources more easily than the others? Therefore, the tenth hypothesis is as follows (Figure 3.2):

> **<u>Hypothesis 10 (H_{10})</u>**
>
> *Successful deployment of entrepreneurial leadership capacity (ELC) is more likely to acquire the resources in high-technology ventures.*

Figure 3.3 lists the following instruments being measured in resource acquisition: skilled employees, general management expertise, marketing and sales expertise, technical expertise, financing, distribution, source of supply, production facilities, and licences, patents and legal protection (Morris et al. 2000; Shane 2003). With the recognition of innovation barriers and the types of innovation in ELC, the entrepreneurs will have the ability to know what kinds of resources needed to be acquired in high-technology ventures.

5. Process Management

Process management can ensure a process with explicit goals that guide the employees to perform consistently and managers to improve it in a disciplined way. Process management engages the organising activities for the exploitation of entrepreneurial opportunities in the process. These organising activities include the creation and design of organisation, planning the modes of exploitation (e.g. spin-off, independent start-up, corporate venturing and acquisition/licensing) (Shane 2003). In order to exploit the recognised opportunity for which the resources have been assembled, the entrepreneur has to implement process management to ensure the smoothness or the effectiveness of the entrepreneurial process.

How can some entrepreneurs monitor the process management better than the others? Therefore, the eleventh hypothesis is as follows (Figure 3.2):

> **Hypothesis 11 (H_{11})**
>
> *Successful deployment of entrepreneurial leadership capacity (ELC) is more likely to have start-up process management in high-technology ventures.*

In Figure 3.3, it shows the following instruments being measured in process management: absorption of new concept into mainstream operations, licensing of rights to another company, calculating the uncertainty of opportunities/risk and company organisation design (Morris et al. 2000; Shane 2003). With the recognition of innovation barriers and the types of innovation in ELC, the entrepreneurs will have the ability to monitor the process management much better by demonstrating the entrepreneurial leadership skills in high-technology ventures.

3.4.1.8 Relationship of Entrepreneurial Leadership Capacity and Enhanced Organisational Achievement

With good business concept, the entrepreneurs with ELC can pursue the entrepreneurial process successfully with the outcome of enhanced organisational achievement. In this new model of EELC, business models and enterprise performance as the enhanced organisational achievement are being studied in high-technology industry. As a viable company for enhanced organisational achievement, preparing business models can help the entrepreneur formulate good organisational strategies with specific goals leading to better enterprise performance.

How can some entrepreneurs achieve enhanced organisational achievement with good business models and satisfactory enterprise performance more easily than the others? Therefore, the twelfth hypothesis is as follows (Figure 3.2):

Hypothesis 12 (H_{12})

Successful deployment of entrepreneurial leadership capacity (ELC) is more likely to have enhanced organisational achievement (business models and enterprise performance) in high-technology ventures.

In Figure 3.3, it lists the following instruments being measured in enhanced organisational achievement: business models (strategic alliance with partners, refocussed current product development, launch new products, raised public capital, raised private capital, acquisition and merger) and enterprise performance (managerial skills, efficiency/speed of product development, skilled labour, quality of product, marketing capability, collaboration with universities/research centres, government support, collaboration with industrial companies, access to seed/venture capital, collaboration with other biotechnology companies, access to domestic markets, physical proximity to collaborators, access to international markets, ability to recognise commercial application of technology, learning from end users, technology transfer from suppliers/inventors and research capability) (Morris et al. 2000; Shane 2003; Hall & Bagchi-Sen 2002). With the recognition of innovation barriers and the types of innovation in ELC, the entrepreneurs will have the ability to achieve enhanced organisational achievement with good business models and satisfactory enterprise performance in high-technology ventures.

The entrepreneur with the entrepreneurial leadership capacity will influence the modes of opportunity exploitation with appropriate business models and satisfactory enterprise performance as the enhanced organisational achievement in high-technology ventures.

3.4.1.9 Relationship of Entrepreneurial Process and Enhanced Organisational Achievement

The entrepreneurial process for venture creation involves these three stages: opportunity discovery, evaluation and exploitation (Shane & Venkataraman 2000). In this proposed new model of EELC, the five entrepreneurial steps are: presence of opportunity; opportunity recognition; decision for opportunity exploitation; resource acquisition and process management. All five entrepreneurial steps are classified into these three entrepreneurial process stages. These five entrepreneurial steps follow the process sequence as shown in Figure 3.2. With good entrepreneurial process, it will lead to enhanced organisational achievement with business models and enterprise performance (Figure 3.2).

Is there any relationship between the entrepreneurial steps and enhanced organisational achievement? The following five (5) hypotheses (**H_{13} - H_{17}**) will investigate this relationship (Figure 3.2):

Hypothesis 13 (H_{13})

Presence of opportunity will positively influence the opportunity recognition in high-technology ventures.

Hypothesis 14 (H_{14})

Opportunity recognition will positively influence the decision for opportunity exploitation in high-technology ventures.

Hypothesis 15 (H_{15})

Decision for opportunity exploitation will positively influence the resource acquisition in high-technology ventures.

Hypothesis 16 (H_{16})

Resource acquisition will positively influence the start-up process management in high-technology ventures.

Hypothesis 17 (H_{17})

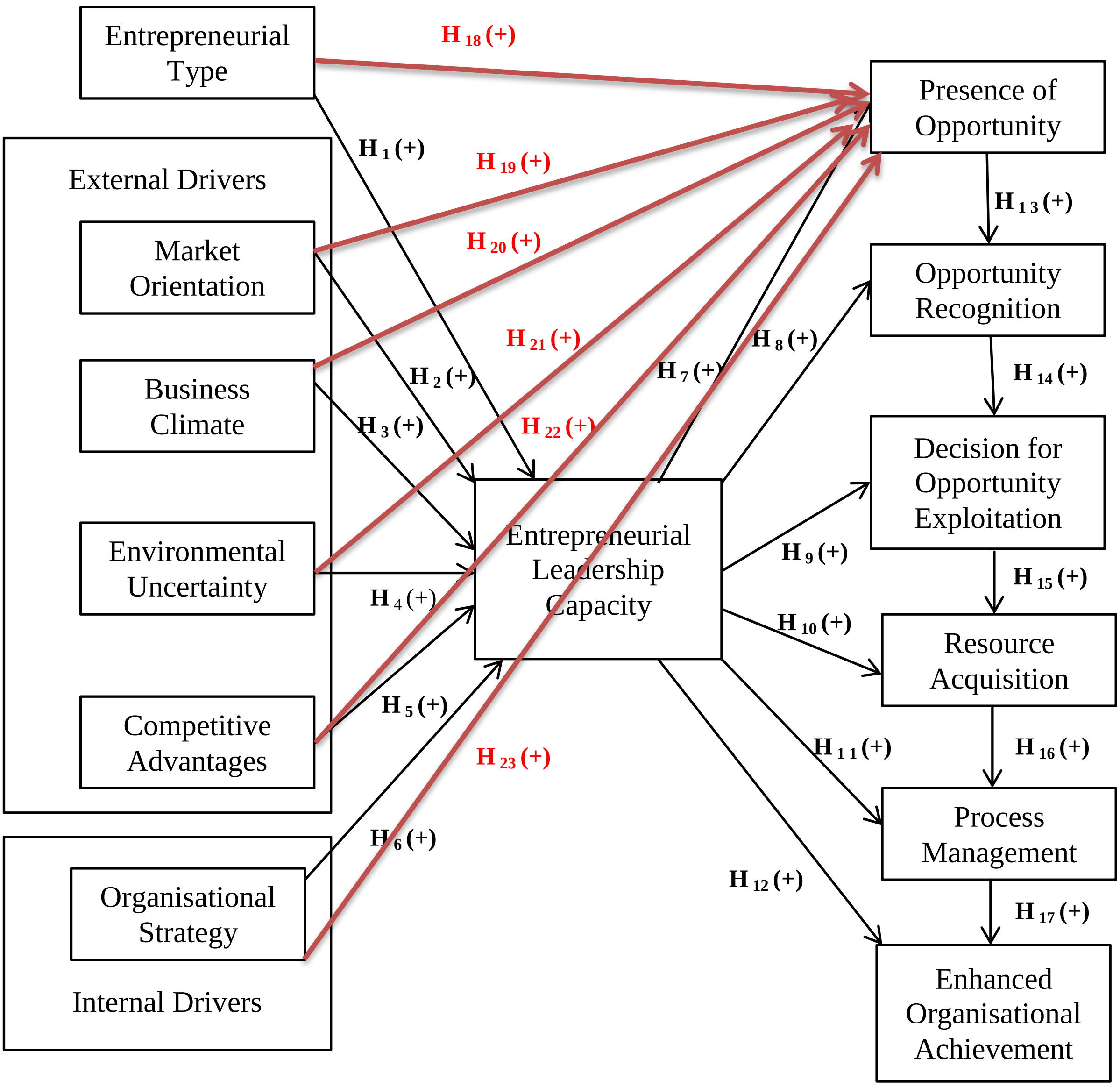
Start-up Process management will positively influence the enhanced organisational achievement (business models and Enterprise performance) in high-technology ventures.

These five hypotheses (**H_{13} - H_{17}**) will study the positive influence of individual construct according to the sequence shown in (Figure 3.2). Is there any significant difference between two constructs sequentially? Which entrepreneurial step is critical for getting to enhanced organisational achievement? Answers should be provided by these five hypotheses (**H_{13} - H_{17}**).

3.4.1.10 Additional Hypotheses

Besides the seventeen hypotheses (**H_1 - H_{17}**) to test the proposed new EELC model, next six hypotheses (**H_{18} - H_{23}**) will test the impact of the mediator role from entrepreneurial leadership capacity (ELC) between the independent variables and the dependent variables in high-technology ventures (Figure 3.2). These six hypotheses (**H_{18} - H_{23}**) will test in the absence of the mediator "Entrepreneurial Leadership Capacity" whether each independent variable will have positive association with the construct "Presence of Opportunity" which is the beginning of entrepreneurial process for high-technology ventures (Figure 3.4). The main objective is to check the presence of mediating effect of ELC.

Figure 3.4 Twenty-three (23) hypotheses for research model of entrepreneurship with entrepreneurial leadership capacity (EELC) for high-technology ventures



Source: Author's own compilation

Therefore, these six hypotheses (**H_{18} - H_{23}**) are listed in the following:

Hypothesis 18 (H_{18}):

The entrepreneurial type is more likely to find the presence of opportunity in high-technology ventures

Hypothesis 19 (H_{19}):

Market orientation is positively associated with the presence of opportunity in high-technology ventures

Hypothesis 20 (H_{20}):

Business climate is positively associated with the presence of opportunity in high-technology ventures

Hypothesis 21 (H_{21}):

Environmental uncertainty is positively associated with the presence of opportunity in high-technology ventures

Hypothesis 22 (H_{22}):

Competitive advantages are positively associated with the presence of opportunity in high-technology ventures

Hypothesis 23 (H_{23}):

Organisational strategy is positively associated with the presence of opportunity in high-technology ventures

In the new EELC model, the main aim is to demonstrate the significance of the mediating role of entrepreneurial leadership capacity (ELC) between the independent variables and dependent variables **(H_1 - H_{17})**. Without ELC, the entrepreneurial process will not be initiated or performing to obtain the enhanced organisational achievement which will be demonstrated from Hypothesis 18 to Hypothesis 23 (**H_{18} - H_{23})**. These six hypotheses are functioning as the controls to verify the importance of ELC in the new model of EELC.

3.5 Chapter Summary

There has been enormous interest in studying the relationship of entrepreneurship and venture growth. The significance of entrepreneurship has been recognised and widely studied as one of the driving forces both in improving the economy and in the creation of wealth and jobs (OECD 1998).

There are many personal characteristics common among entrepreneurs and leaders such as adaptability, persistence, achievement orientation and high level of energy (Dalglish & Evans 2000). In the context of entrepreneurship, this “leadership” can be described as “entrepreneurial leadership” which Kuratko and Hornsby (1998) suggest may be the emerging critical factor for the twenty-first century corporation. Leadership capacity is concerned with a leader’s experience, credibility, willingness to assume responsibility, ability to tolerate stress, and assertiveness (Street et al. 2011). The combination of leadership capacity and entrepreneurial leadership is called as “entrepreneurial leadership capacity” (ELC).

By combining the definitions of leadership capacity and entrepreneurial leadership, the author has come up with this definition of ELC as

> “the extent, in an ever-changing business environment, the entrepreneurs/organisations can optimise their current and future leadership ability for anticipation, envision, flexibility, creative and strategic thinking, research and development for appropriate innovative inventions, recognition of innovation barriers, knowledge management, entrepreneurial activities for

venture creation and initiation for collaborative change with sustainable business results and successful attainment of challenges and opportunities for a viable future for the organisation."

In this proposed new model of entrepreneurship for high-technology ventures (Figure 1.1), it incorporates the entrepreneurial leadership capacity (ELC) as the relationship mediator (e.g. types of innovation, recognition of innovation barriers from financial, regulatory and resource perspectives) (Kuratko & Hornsby 1998; Hitt, Ireland & Hoskisson 2001) together with the four widely studied dimensions as below (Gartner 1985):

1. The entrepreneur (entrepreneurial types): Entrepreneurial type theory as the related theory for model development.
2. The external drivers (market orientation, business climate, environmental uncertainty and competitive advantages) and internal/organisational driver (e.g. organisational strategy): Environmental dynamism theory as the related theory for model development.
3. The entrepreneurial process (presence of opportunity, opportunity recognition, decision for opportunity exploitation, resource acquisition, process management): Entrepreneurial process model as the related theory for model development.
4. Enhanced organisational achievement (business models and enterprise performance): No particular model/framework found for model development.

In the development of an EELC model for high-technology ventures, this chapter developed the following twenty three (23) hypotheses listed at 3.4.1.1 above.

The following chapters discuss and report an empirical investigation of these twenty three (23) hypotheses. Chapter 4 describes the development of the research instruments and methodology which underpinned the research.

CHAPTER 4 DEVELOPMENT OF RESEARCH METHODOLOGY

4.1 Chapter Introduction

This chapter explains the development of research methodology including the research design and research method. With deductive strategy for cross-sectional study, this research design can effectively answers the research question as stated in Chapter 1:

What are the factors/drivers and outcomes of a new model of entrepreneurship with entrepreneurial leadership capacity (EELC) for high-technology ventures?

This chapter proceeds in the following sections for the study of new entrepreneurship (EELC) model: the research design, the development of survey questionnaires and research instruments, sample and data collection, the development of measurement model and Partial Least Squares Path Modeling (PLS-PM) for Structural Equation Modeling (SEM)**.** Finally, the chapter closes with chapter summary.

4.2 Research Design

Bryman and Bell (2007) discuss five different research designs:

1. Experimental design;
2. Cross-sectional or social survey design;
3. Longitudinal design;
4. Case study design; and
5. Comparative design.

Since it is not possible to manipulate the variables in the current research on this new model of EELC, the cross-sectional design is being preferred over the experimental design as explained by Bryman and Bell (2007, p. 55):

> "The cross-sectional design entails the collection of data for more than one case (usually quite a lot more than one) and at a single point in time in order to collect a body of quantitative or quantifiable data in connection with two or more variables (usually many more than two), which are then examined to detect patterns of association."

4.2.1 Research Strategy

As the two major research strategies, deductive and inductive research strategies can provide the steps in answering the research questions (Sedmak & Longhhurst 2010). Bryman and Bell (2007) describe that with deductive strategy the researcher can deduce hypotheses based on the knowledge and theoretical considerations of that particular domain. Starting from hypotheses deduced from theory, the data are found to either confirm the hypotheses (in a way supporting the theory), or does not confirm the hypotheses (not supporting the theory but requiring modification or rejection) (Blaikie 2000). Alternatively, an inductive research strategy involves a movement which is in the opposite direction from deduction (Bryman & Bell 2007, p. 14). Inductive research involves the building of theories based on the data which is the outcome (Sedmak & Longhhurst, 2010) and the process of drawing generalised inferences out of observations (Bryman & Bell 2007).

Theory development comprises four essential building blocks such as what, how, why and, who, where and when components (Whetten 1989). The first block is *what* factors logically should be considered in the explanation of phenomena. The second is *how* these factors are related. The third is *why* the causal relationships between the factors are rational while the last block is *who, where, when* the conditions place limitations on the positions generated from a theoretical model

(Whetten 1989). The current research for this new model of the EELC uses the deductive strategy and covers these four building blocks very clearly.

4.2.2 Research Method

Quantitative methods are defined as “the systematic and mathematical techniques used to collect and analyse quantitative data” while qualitative methods are “the techniques by which qualitative data are collected and analysed” (Gray 2009). Quantitative methods are used to generate results for the following purposes: description of numerical changes in a population of interest; provision of an explanation of predictions and the explanation of causal relationships *(*Kraska 2010). Normally, a survey design provides a quantitative data for the numeric description of trends, opinions or attitudes of a sample out of a population (Creswell 2009).

Quantitative research methods were originally developed in the natural sciences to study natural phenomena (Myers 2009). Positivist or objectivist research approach is associated with quantitative research while interpretive or constructivist research approach relates to qualitative research (Schwaninger 2004; Gray 2009). Myers, (2009, p. 37) discusses that “positivist researchers generally assume that reality is objectively given and can be described by measurable properties, which are independent of the observer (researcher) and his or her instrument”. Besides, quantitative research focuses on instrumental rationality which cultivates structuralist–functionalist approaches (Schwaninger 2004). The advantages of quantitative research include theory testing, replicability and generalisability (Johnson & Harris 2002). Some of the disadvantages of quantitative research are the loss or the superficial treatment of social and cultural aspects of organisations (Myers 2009).

On the other hand, qualitative research is the general term used to include a wide variety of research methods and methodologies which provides holistic, in-depth accounts and attempt to reflect the complicated, contextual, interactive, and interpretive nature of the social world such as grounded theory, ethnography and phenomenology etc. (Staller 2010). Qualitative method is good for exploratory research when the new topic is not much previously published (Myers 2009). Qualitative research is the best choice when the researchers need to study the topic in more depth. The major disadvantage of qualitative research is that it is difficult to generalise to a larger population (Myer 2009).

Besides quantitative and qualitative method research, mixed methods research is also being recognised as the third major research approach or paradigm (Johnson, Onwuegbuzie & Turner 2007). According to Creswell, Plano Clark, Gutmann and Hanson (2003, p. 212), mixed methods research has been defined as

> "the collection or analysis of both quantitative and qualitative data in a single study in which the data are collected concurrently or sequentially, are given a priority, and involve the integration of data at one or more stages in the process of research".

Bryman (2007b) points out that there is currently an absence of well-known examples of mixed methods research but the research trend with these mixed methods is emerging. Among the benefits that mixed methods to provide the researchers is to allow the simultaneous generalisation from a sample to a population and to gain a richer, contextual understanding of the phenomenon being researched in the study (Hanson, Creswell, Plano Clark, Petska & Creswell 2005).

On the other hand, there are some potential weaknesses of mixed methods research (Gray 2009). The benefit of mixed methods should not always be assumed by the researchers (Fielding & Fielding 1986). However, at the end of a mixed methods project, the end product should be more than the sum of the individual quantitative and qualitative parts (Bryman 2007b). According to Bryman (2007a), the mere convergence of research results from quantitative and qualitative methods does not inevitably assure validity due to the misinterpretation of commonalities and differences when data sets are collected by incompatible methods. Gray (2009) mentions that another source of discrepancy from mixed methods is associated with measurement. Since quantitative studies may rely on pre-existing standardised measurement scales and may have been satisfactorily tested by researchers for reliability, they may not correspond sufficiently with the constructs being measured. Consequently, between-group differences can appear in the qualitative study, but not be found in the quantitative method. In addition, collecting both quantitative and qualitative data are very expensive from the practical perspective due to the increased time required for the interviews or participant observation (Gray 2009). The problem can also arise in synthesising the findings and interpretations from the quantitative and qualitative approaches.

Furthermore, Bryman (2006) discovered in an analysis of mixed methods articles that in many cases the quantitative and qualitative elements had barely been integrated at all. Bryman (2007b) draws the conclusion that there is still considerable confusion concerning how mixed methods findings can be integrated. It is argued that mixed methods are nothing more than "positivism dressed in drag" (Giddings 2006, p. 198). Instead of offering the "best of both worlds", mixed methods finds itself located within the thinking of positivism because it rarely reflects a constructionist or subjectivist view of the world.

After considering the advantages and disadvantages of the above-mentioned three approaches, the current study of EELC model is using a quantitative research method because the reality of the phenomena (the entrepreneurial type, market orientation, business climate, environmental uncertainty, competitive advantages, organisational strategy, presence of opportunity, opportunity recognition, decision for opportunity exploitation, resource acquisition, process management, business models and enterprise performance) in this model is assumed to be objectively given; and these phenomena can be described by measurable properties. In addition, the current study emphasises the instrumental rationality.

This new model (EELC) was applied to study high-technology industry such as biotechnology, a science-based industry, to simply validate its preliminary findings. The research design of the sample survey of the Australian biotechnology companies is based on quantitative methods (Gray 2009; Kraska 2010). In this research of an EELC model as shown in Figure 1.1, the independent variables are the entrepreneurial type (personal achiever (PA), super sales people (SS), expert idea generator (EI) and real manager (RM)), the external drivers (market orientation, business climate, environmental uncertainty and competitive advantages) and the internal driver (organisational strategy) while the dependent variables are the entrepreneurial process (presence of opportunity, opportunity recognition, decision for opportunity exploitation, resource acquisition, process management) and the enhanced organisational achievement (business models and enterprise performance). Independent variables will act upon dependent variables only indirectly via an intervening variable which is the entrepreneurial leadership capacity (ELC) (types of innovation and; recognition of innovation barriers from financial, regulatory and resource perspectives) as the mediator.

In the development of the new model, a set of twenty three hypotheses were also structured to test the validity of this new model of entrepreneurship for high-technology ventures. Using thirty nine (39) high-technology firms as the sample size of the biotechnology industry, company visits were conducted by using structured survey questionnaire interviews. Their responses provide quantitative data to test the validity of this new model. Descriptive statistics are used to summarise the data in the analysis. Inferential statistics are applied to draw inferences from the sample chosen for a larger population that the sample is drawn from (Gray 2009).

4.3 Development of Survey Questionnaire and Research Instruments

Prior to the research study being conducted, the survey questionnaire had to be developed according to the scope of study. From the literature review, measure constructs as the research instruments based on the research questions are also developed for the survey questionnaire. The following sections will discuss the development of survey questionnaires and research instruments.

4.3.1 Development of Survey Questionnaire

The design and layout of the survey questionnaire follow the flow shown in Figure 1.1 which describes the proposed EELC model for high-technology ventures. Biotechnology industry was being studied as the high-technology venture to validate this new model of EELC. The questionnaire consisted of forty-five questions in three sections: company information, research model (entrepreneurial process for venture growth, entrepreneur, entrepreneurial leadership capacity, external and organisational drivers, and enhanced organisational achievement), and miscellaneous. Among the twenty-two questions in the first section, the key executive of the surveyed Australian biotechnology firms had to provide general company information, for example, the origin of the company (university spin-off or independent venture), distribution of revenue from sources, technology sector, major technology expertise, percentage of total expenditure spent on R&D expenses and reasons for company formation. Twenty questions were used to study the new entrepreneurship model including an entrepreneurial process for venture growth, entrepreneur, entrepreneurial leadership capacity, external and organisational drivers, and enhanced organisational achievement in depth in the second section. The last three questions were used to collect the information about the challenges faced by the high-technology venture, and the feedback or comments on the survey.

An extensive detailed questionnaire was designed after pre-testing in a small survey group. The purpose of the pre-test was to identify any problem with the survey instrument. The process allowed time for each participant to complete the survey and the time for completing it would be recorded. A follow-up interview was conducted with each participant to identify any weaknesses in the instrument. The questionnaire was then finalised with those changes after obtaining the opinions of participants regarding the meaning and clarity of the questions.

The final survey questionnaire was mailed out to the selected sample (Appendix C). After the survey was conducted, the data was prepared and analysed statistically with Partial Least Squares Path Modeling (PLS-PM) for Structural Equation Modeling (SEM).

4.3.1.1 Ethical Considerations

In the design of the questionnaire, special attention was paid to the ethics issues. The final draft of the questionnaire was carefully reviewed and approved by the Ethics Review Committee of Macquarie University before it was used in the field survey (Appendix A1).

A number of conditions were imposed by the Ethics Review Committee. A consent form with full explanation of the terms and conditions had to be completed by the interviewee before the interview was conducted (Appendices A2 and B). Strict guidelines for post-interview storage and security of data were also imposed. The collected data, such as the names and affiliations of interviewees cannot be disclosed to anyone in any form, except to my supervisor and the Ethics Review Committee. Strict confidentiality is applied to these collected data.

4.3.2 Development of Research Instruments

This section discusses the development of research instruments that were developed for studying the EELC model. The main objective of this study is to identify the factors/drivers and outcomes of a new model of the EELC for high-technology ventures.

A questionnaire was developed to measure the factors or variables of the research model of EELC. The measurement items were based on previous works from various literatures and findings from field studies. Table 4.1 details the measurement items of each variable with their special question number in the questionnaire, assigned reference codes and related references for all the constructs in this EELC model. The development of measurement instruments can be referred to Table 4.1 clearly.

Table 4.1 Measurement instruments for the research model of entrepreneurship

Variable	Construct measure	Question number	Assigned reference code	References
Entrepreneur (EN)	**<u>Entrepreneurial types (ET)</u>** - Personal achiever - Super sales people - Expert idea generator - Real manager	24	 ETPA ETSS ETEI ETRM	Miner (2000); Morris et al. (2000);
External driver (ED)	**<u>Market orientation (MO)</u>** - Identified customer needs - Emerging industry - High market growth rate (eg 30-50%) - High gross margin (e.g. 40-50%) - Reasonable market share (e.g. 20%)	38	 MOIC MOEI MOMR MOGM MOMS	Morris et al. (2000; 2007); Barrett & Weinstein (1998)
	<u>Business climate (BC)</u> - Good profit after tax (e.g. 10-15%) - Short time to break even and positive cash flow (e.g. under 2 years) - Low to moderate capital requirements	39	 BCPT BCBE BCCR	Morris et al. (2000); Vitale (2004)
	<u>Competitive advantages (CA)</u> - Low fixed and variable costs for production/marketing/distribution - Moderate to strong degree of control for prices/costs/channels of supply etc - Barriers to entry for proprietary protection/lead time/legal advantage - Product differentiation	40	 CAFC CACP CABE CAPD	Morris *et al*. (2000)
	<u>Environmental uncertainty (EU)</u> - Political infrastructure in society - Legal infrastructure - Regulatory infrastructure - Socio-cultural infrastructure - Financial infrastructure	41	 EUPI EULI EURI EUSI EUFI	Morris et al. (2000); Spekman & Stern (1979)
Organisational drivers (OD)	**<u>Organisational strategy (OO)</u>** - Logistical infrastructure - Within-company infrastructure - Networks/contacts - Management team expertise - Risk control	42	 OOLI OOCI OONC OOMT OORC	Morris et al. (2000); Hall & Bagchi-Sen, (2002);
Entrepreneurial leadership capacity (ELC)	**<u>Types of Innovation (TI)</u>** - New to the world product or service - New to the firm product or service in line that at least one competitor is offering - New to the country and/or market product or service - New application of existing product or service, including application to a new market segment - Addition to a company's existing product or service line	28	 TINW TIFP TICM TIEP TIAP	Hall & Bagchi-Sen, (2002); Morris et al. (2000); Vitale (2004)

	- Repositioning of an existing product or service - Product/service improvement, revision, including application of new feature or option or change - Process improvement for new administrative system or procedure - Process improvement for new production method - Process improvement for new marketing or sales approach - Process improvement for new customer support program - Process improvement for new logistical approach - Process improvement for new pricing approach - Process improvement for new distribution channel or method - Process improvement for new financing method - Process improvement for new purchasing technique - Process improvement for new organisational form or structure **Recognition of innovation barriers (IB)** Financial - Lack of venture capital in early stage of venture - Lack of public funds in early stage of venture - Lack of government research funds in early stage of venture - Lack of venture capital in late stage of venture - Lack of public funds in late stage of venture - Lack of government research funds in late stage of venture Regulatory - Australian government regulations (eg state or federal) - Foreign government regulations (eg CE/EMEA approval etc) - Australian patent process - Foreign patent process - TGA approval process - FDA approval process Resource - Lack of skilled managers - Lack of skilled researchers - Lack of research facilities/assets - Lack of manufacturing facilities - Lack of marketing/distribution channels - Lack of clinical trial facilities	31	TIRP TIPS TINA TINP TINM TINC TINL TIPR TIND TIFM TIPT TIOF IBVCE IBPFE IBGRE IBVCL IBPFL IBGRL IBAG IBFG IBAP IBFP IBTGA IBFDA IBSM IBSR IBRF IBMF IBMC IBCTG	Hall & Bagchi-Sen, (2002); Morris et al. (2000); Vitale (2004) Hall & Bagchi-Sen, (2002); Morris et al. (2000); Vitale (2004)
Entrepreneurial	**Presence of opportunity (PO)**	23		

Process (EP)	- In market (e.g. needs, customers and potential market size) - In Economy (e.g. profits after tax and time to break even etc.) - In competitive advantage (e.g. barrier to entry, and degree of control over costs and prices etc.) - In network/management expertise/risk control **Opportunity recognition (OR)** - Changing demographics - Emergence of new market segments - New process needs - New technologies - Incongruities/ Lack of harmony - Regulatory change - Social change **Decision for opportunity exploitation (DOE)** - New products - New services - New processes - New markets - New organisational structure/forms - New technologies - New sales or distribution channels **Resource acquisition (RA)** - Skilled employees - General management expertise - Marketing and sales expertise - Technical expertise - Financing - Distribution - Source of supply - Production facilities - Licences, patents and legal protection **Process management (PM)** - Absorption of new concept into mainstream operations - Licensing of rights with other company - Calculating the uncertainty of opportunities/risk - Company organisation design		POIM POIE POCA PONR ORCD ORNMS ORNPN ORNT ORILH ORRC ORSC DOENP DOENS DOENPC DOENM DOENOS DOENT DOENSC RASE RAGME RAMSE RATE RAF RAD RASS RAPF RALP PMNC PMLR PMUO PMOR	Morris et al. (2000); Shane (2003) Morris et al. (2000); Shane (2003) Morris et al. (2000); Shane (2003) Morris et al. (2000); Shane (2003) Morris et al. (2000); Shane (2003)
Enhanced organisational achievement (EOA)	**Business model (BM)** - Strategic alliance with partners - Refocussed current product development - Launch new products - Raised public capital - Raised private capital - Acquisition - Merger **Enterprise performance (EP)**	36 37	BMSA BMRCP BMLNP BMPUC BMPRC BMA BMM	Morris et al. (2000); Shane (2003); Morris, Schindehutte & Allen (2005)

	- Managerial skills - Efficiency/speed of product development - Skilled labour - Quality of product - Marketing capability - Collaboration with universities/research centres - Government support - Collaboration with industrial companies - Access to seed/venture capital - Collaboration with other biotechnology companies - Access to domestic markets - Physical proximity to collaborators - Access to international markets - Ability to recognise commercial application of technology - Learning from end users - Technology transfer from suppliers/ inventors - Research capability		EPMS EPEPD EPSL EPQP EPMC EPCU EPGS EPCIC EPASV EPCBC EPDM EPPPC EPAIM EPACA EPLEU EPTTI EPRC	Morris et al. (2000); Shane (2003); Hall & Bagchi-Sen (2002)

The model contains fourteen (14) factors with one hundred and sixteen (116) items measured, namely, entrepreneurial type (4 items measured), market orientation (5 items), business climate (3 items), environmental uncertainty (5 items), competitive advantages (4 items), organisational strategy (5 items), entrepreneurial leadership capacity (35 items), presence of opportunity (4 items), opportunity recognition (7 items), decision for opportunity exploitation (7 items), resource acquisition (9 items), process management (4 items), business models (7 items) and enterprise performance (17 items).

The process of measurement includes assigning symbols to characteristics of persons, events or objects. The symbols that are being used are often numbers to allow for statistical manipulation of data (Diamantopoulos & Winklhofer 2001). Choosing the right type of scale has been subject to academic debate in several studies. Jöreskog (2005) claimed that the Likert scale is an ordinal variable in the essence of its origins or units of measurement, its distribution being discrete, and does not have values between numbers. Hence, to use Structural Equation

Modeling (SEM) with ordinal variables requires techniques other than those traditionally employed with continuous variables – Maximum Likelihood (ML). In practice, however, it is reported that during the past 15 years, the application of SEM has mostly relied on the Likert scale, in which ML is used to estimate the parameters (Jöreskog 2005).

Researchers have been debating the optimal number of scale points to use. Many authors concluded that the optimal number of scale categories is content-specific and a function of the conditions of measurement (Matell & Jacoby 1991; Garland 1991). Hair, Money, Samouel and Page (2007) stated there are two choices, between odd and even number in selecting scale categories.

In this study, instrument items were measured on a five-point Likert-type scale, ranging from "not important" to "extremely important". Most interviewees were asked to rank each factor in the degree of importance based on the Likert scale of 1-5 (1=not important; 3=important; 5=extremely important).

4.4 Sample and Data Collection

After the design of the survey questionnaire was done, careful planning for sample and data collection had to be structured during the research period. The following sections will discuss these two topics.

Sample Collection

1. Sample Selection

A sample is used in much of the business research over the whole population because of cost and time issues. A sample is a subset of a population which is a representative sample demonstrating the similar or identical characteristics to those of the population (Gray 2009).

A sampling error can occur when a sample is drawn from the population. The existence of sampling error demonstrates a discrepancy between the sample statistic and the population parameter if the sample statistic differs in size from the population parameter (Gray 2009). The sampling error can be statically evaluated if the sample was obtained by means of probability sampling.

Probability and non-probability sampling are the two types of basic sampling techniques (Schuyler, Beavers & Esquivel 2010). Probability sampling is defined as "the techniques used to ensure that a sample is representative of the population, so that findings can be generalised to that population" (Gray 2009, p. 580). Probability sampling follows a procedure whereby every respondent in the defined population has a non-zero chance of being selected.

Non-probability sampling is quite common and frequently applied in business research (Schuyler, Beavers & Esquivel 2010). Non-probability sampling is defined as "the techniques used to draw a sample in such a way that the findings will require judgement and interpretation before being applied to a population" (Gray 2009, p. 578). Non-probability sampling requires less planning in identifying the correct respondents when compared to probability sampling. Non-probability sampling leaves the sample selection to the discretion of the researcher (Schuyler, Beavers & Esquivel 2010). However, non-probability sampling provides no generalisation about the population parameters (Gray 2009).

There are four types of non-probability sampling, namely, purposive sampling, snowball sampling, convenience sampling and quota sampling (Schuyler, Beavers & Esquivel 2010). Purposive sampling is described as "a non-probability sampling strategy in which participants are selected on the basis that they are considered to be typical of a wider population" (Gray 2009, p. 580). Snowball sampling is "the non-probability sampling strategy through which the first group of participants is used to nominate the next cohort of participants" (Gray 2009, p. 581). Convenience sampling is referred as the non-probability strategy that uses the most conveniently accessible people to participate in the study (Gray 2009, p. 575). Finally, quota sampling is "a non-probability sampling strategy in which various strata are identified by the researcher who ensures that these strata are proportionately represented within the sample to improve its representativeness" (Gray 2009, p. 580).

In the study of this proposed model of EELC, a non-probability sample was used with purposive sampling and snowball sampling. The scope of this entrepreneurial research covered more than just start-up firms. It also covered firms in all phases including start-up, early venture, expansion and maturity phases. As stated previously, the chosen high-technology industry to which the survey questionnaire was applied was the biotechnology industry. In this study, the sample of biotechnology firms involved in the Australian study was drawn from the publicly-listed companies in the Australian Stock Exchange (ASX) and the private companies documented in the Australian Biotechnology 2005 directory (AusBiotech 2005). From an initial list with contact details of persons, the relevant management level was identified, such as the founder or the chief executive officer (CEO) or chief technical director etc. In a second step, a snowball sampling approach was taken. Persons from the original list were asked to refer other colleagues from their organisation who would be able to participate in the structured questionnaire survey. The main reason for taking a non-probability sampling technique was that respondents in management are very difficult to identify and to contact. The basis of this study is the extensive detailed questionnaires completed by key executives in the biotechnology enterprises concerned.

2. Sample Size

Sample size refers to the number of subjects in a study (Acheson 2010). The sample size of a study plays a crucial aspect of an experimental design. Running a study with the too small sample size may have risks, namely, inaccurate reflection of the population a sample was drawn from, failing of finding a real effect due to inadequate statistical power, finding apparent effects that cannot be replicated in subsequent experiments (Acheson 2010). However, using more subjects than necessary is a costly drain on resources that slows completion of studies. It is ethically preferable to use the minimum sample size necessary for running the study.

Sample size planning is a good tool to practice in experimental design. This sample size planning is the systematic approach to selecting an optimal number of participants to include in a research study so that some specified goal or set of goals can be satisfied (Kelley 2010). This plan addresses the question of sample size being used in the research study. The appropriate sample size depends on the research questions of interest, the statistical model used, the assumptions specified in the sample size planning procedure and the goal(s) of the study (Kelley 2010).

There are several commercially available software programs for estimating required sample size based on study design, estimated effect size, desired statistical power, and significance thresholds. Besides, free software for estimation program such as sample size calculator, can be found through Internet search engines. The sample size calculator determines how many people you need to survey or interview in order to get results reflecting the target population as precisely as needed (Sample Size Calculator n.d.). In addition, the sample size calculator can also be used to find the level of precision present in an existing sample. Confidence interval (e.g. 5%, 10% or 15% etc.) and confidence level (e.g. 95% or 99%) need to be decided when the sample size planning is considered.

In the sample size calculator (Sample Size Calculator n.d.), the confidence interval or margin of error is referred as the plus-or-minus figure usually reported in newspaper or television opinion poll results. For example, if you use a confidence interval of 5 and 45% of your sample picks an answer you can be "sure" that if you had asked the question of the entire relevant population between 40% (45-5) and 50% (45+5) would have picked that answer. There are two factors that determine the size of the confidence interval for a given confidence level, sample size and population size (Sample Size Calculator n.d.).

The confidence level tells you the certainty you can use. It is expressed as a percentage and represents how often the true percentage of the population who would pick an answer lies within the confidence interval. The 95% confidence level means you can be 95% certain which is the level most researchers will use in research (Sample Size Calculator n.d.).

In terms of the influence of sample size, the larger is your sample size, the more sure you can be that their answers truly reflect the population. This indicates that for a given confidence level, the larger your sample size, the smaller your confidence interval. On the other hand, the smaller is your size, the larger is your confidence interval. However, the relationship is not linear. Doubling the sample size does not halve the confidence interval (Sample Size Calculator n.d.).

From the above example, when you put the confidence level and the confidence interval together, you can say that you are 95% sure that the true percentage of the population is between 40% and 50%. The wider the confidence interval you are willing to accept, the more certain you can be that the whole population would be within that range.

In the process of sample size planning, Table 4.2 lists different scenarios with various response rates for the study of EELC model. In Table 4.2, different sample size needed for the study can be calculated by changing the variable of the confidence interval (e.g. 5%, 10%, 15% or 20%) with the fixed confidence level of 95% and the population size of 121 Australian biotechnology firms surveyed. Detailed of the results will be discussed in Chapter 5. Response rates can be calculated from the percentage of sample size needed over the population size.

Table 4.2 Sample size planning with various response rates for the study of EELC model

	Scenario 1	Scenario 2	Scenario 3	Scenario 4	Actual Study
Confidence interval	5%	10%	15%	20%	13%
Confidence level	95%	95%	95%	95%	95%
Population size	121	121	121	121	121
Sample size needed	92	54	32	20	39
Response rate	76%	44.6%	26.5%	16.5%	32.2%

Note: Sample size needed was calculated by sample size calculator (Sample Size Calculator n.d.)

For high response rate of 76%, which was very hard to obtain in a study, the sample size needed would be 92 out of 121 firms of population size with 5% confidence interval and 95% confidence level (Table 4.2). For the response rate of 44.6%, the sample size needed would be 54 out of 121 firms of population size with 10% confidence interval and 95% confidence level.

In considering the sample size of this study, the planned response rate would be between 30% and 40%, which is considered acceptable in business research. From this target response rate (30% - 40%), the estimated sample size needed would be between 35 and 48 biotechnology firms (Table 4.2). For the response rate of 32.2% in the actual study, the sample size needed would be 39 out of the 121 firms in the population, with 13% confidence interval and 95% confidence level.

As mentioned earlier, respondents to this survey were specifically Australian key executives in the biotechnology enterprises who were involved in decision-making and had experiences in the entrepreneurial process for venture growth. The type of respondents in this research may account for the low response rate, especially among senior managers. Thong and Yap (1995) caution that questionnaires targeted at senior executives would yield lower response rates than questionnaires completed by junior executives. With high-level executives, surveys that are perceived to be complex and time-consuming would have a greater chance of failure, and therefore lead to poor response rates (Thong & Yap, 1995). Therefore, this study considered that providing the potential survey participants with an accurate estimate of how long the questionnaire would take to complete was important, as executives in Australian biotechnology firms are likely to be constrained by time. The time estimate also provided a good guide on how well participants would respond to the survey requests (Thong & Yap 1995).

In the literature review, various studies were done based on small sample size leading to significant contributions to theory building in entrepreneurship. Amit & Zott (2001) used thirty (30) companies as the sample size to study the value creation of e-Business while Bhave (1994) surveyed a taxonomic sample of twenty-seven (27) entrepreneurial firms for studying the entrepreneurial process model for value creation. Baker and Nelson (2005) studied how twenty-nine (29) resource-constrained firms created opportunities through entrepreneurial bricolage.

Shane (2000) studied eight (8) companies to test how the prior knowledge helped discover the entrepreneurial opportunities. From these evidences in the literature, small sample size ranging between eight (8) and thirty (30) sample size could still be valid and contribute significantly in theory building for entrepreneurship. In this study of EELC model, a sample size of thirty nine (39) biotechnology firms was still valid and sufficient for building the theory of entrepreneurship.

In addition, since the Australian biotechnology industry is still in an early stage of development, the size of most biotechnology start-ups is not very big. On most occasions, those start-ups will only have one or two staff to start with, for example, the founder or the chief executive officer (CEO) and the secretary. It was extremely hard to get the agreement from the senior executive to commit their time to do one hour face-to-face questionnaire survey. Thirty-nine (39) out of 121 biotechnology firms of population size was not a small sample size leading to 32.2% of response rate. This response rate was very satisfactory in an emerging industry like biotechnology with a small population size. The biotechnology industry is different from those popular high-technology industries such as information technology with huge population size for sampling in the study.

Data Collection

After the extensive detailed questionnaire was designed and the sample selection was also planned, the next phase would be the data collection. Various methods were used to conduct the questionnaire survey via face-to-face interviews, mail or email depending on the availability of the personnel. This study used the method of semi-structured interview to collect relevant data in order to explore the constructs in the EELC model. The semi-structured interview questions focused on the information needed in the field study. This covered the background questions (company history, position of interviewee and company specialisation, etc.) and the guiding questions (factors for influencing entrepreneurial process, the role of entrepreneurial leadership capacity and the enhanced organisational achievement, etc.).

The first priority was to arrange a face-to-face interview at each identified biotechnology firm. Prior to the visit, telephone calls or emails were made to contact the key executives of the enterprises. Personal visits across the five Australian states were arranged so that the face-to-face interviews could be conducted to complete the questionnaire. Follow-up telephone calls and emails were made to confirm the appointment to visit. Normally the completed questionnaires were collected at the end of the one-hour interview period. For those senior executives who could not commit the time for a face-to-face interview, the questionnaire would be mailed out to companies sampled. Telephone calls or emails of the questionnaires were made to encourage the key executives to complete the questionnaire on time.

After the survey was conducted, the data was prepared and analysed statistically with Partial Least Squares Path Modeling (PLS-PM) for Structural Equation Modeling (SEM).

4.5 Developing Measurement Model

To develop the measurement model, there were two major steps to be taken: i) Exploratory Factor Analysis (EFA); and ii) Confirmatory Factor Analysis (CFA). By dropping an indicator from the construct, it does not alter the conceptual domain of the reflective construct. However, it will alter the conceptual domain of the formative construct (MacKenzie, Podsakoff & Jarvis 2005; Jarvis et al. 2003). EFA was performed on the reflective measurement models. After performing the EFAs for the reflective measurement models, the confirmatory factor analyses (CFA) were also conducted. The purpose in conducting CFAs was to examine the construct validities of reflective measurement models.

The following section will discuss the validity and reliability of research, Exploratory Factor Analysis (EFA) and Confirmatory Factor Analysis (CFA)

4.5.1 Validity and Reliability of Research

Validity is defined as “the degree to which data in a research study are accurate and credible” while reliability is “the degree to which an instrument will produce similar results at a different period” (Gray 2009). Table 4.3 lists out the definitions of these seven types of validity: internal, external, criterion, construct, content, predictive and statistical validity (Gray 2009). The issues of validity are not that simple but very complex in nature. In this study, construct validity and content validity are applicable.

From Table 4.3, only internal and external validity are discussed here. Triangulation of data collection methods has been applied to strengthen the internal validity in this thesis (Creswell 2009). External validity has been used to strengthen the research through a wide variation of samples from major demographic areas while keeping the environmental context quite constant with selection criteria.

Reliability is the dependency and consistency of the measure which is the prerequisite to validity. Reliability is not sufficient on its own (Gray 2009). Reliability is further strengthened by applying a systematic or universal approach to research design and proper documentation of data during the study period (Creswell & Plano Clark 2007).

Table 4.3 Definitions of seven types of validity

Type of Validity	Definition
Internal validity	The extent to which changes in the dependent variable can be attributed to the independent variable, rather than to an extraneous variable
External validity	The extent to which research results can be generalized to the population as a whole
Criterion validity	Assessed through comparing the scores on an instrument with one or more external criteria such as a well-established existing test
Construct validity	The extent to which an instrument measures a theoretical concept (construct) under investigation
Content validity	An estimate of the extent to which a research tool takes an item from the subject domain being addressed, including not only cognitive topics but also behaviours
Predictive validity	The extent to which scores on an instrument can predict a subject's future behaviour in relation to the test's content (e.g. do scores on an engineering aptitude test predict the ability to perform engineering tasks?)
Statistical validity	The extent to which a study has made use of the appropriate design and statistical methods

Source: Gray (2009)

Five types of reliability are applicable to social science research: stability, equivalence, inter-judge reliability, intra-judge reliability and the latter more commonly known as internal consistency (Gray 2009). In this study, internal consistency, commonly referred as reliability, will be determined for all the constructs using Cronbach's alpha. A high degree of inter-correlation can be expected among the items that involve the measure or summated scale which can be measured by Cronbach's alpha (Field 2009).

Scale Reliability

Reduction of measurement errors is required to conduct a thorough measurement analysis of the instrument (Churchill 1983). It encompasses the three dimensions of reliability, validity and unidimensionality. The parameters for those complex constructs were tested at the original scale level.

Unidimensionality describes as the extent to which items on a particular scale estimate that construct or factor (Hattie 1985). Measuring unidimensionality implies that it determines whether as a set of indicators reflect one, as opposed to more than one, underlying factors (Gerbing & Anderson 1988).

With further scale refinement and analyses, detailed statistical results for item descriptives, unidimensionality, correlations and scale reliability were verified for each of the scales. Minimum and maximum score are the statistics need to be done along with the consequent range of responses used by respondents for that particular item, the standard deviation, mean, variance, skewness and kurtosis statistic for each the item.

Appendix D lists the scale reliability and descriptive statistics for construct measures in this study of EELC model. The Cronbach Alpha coefficient, mean and standard deviation are found in Appendix D. A typical value of 0.70 as the reliability coefficient is considered as adequate for reliability while the permissible alpha value ≥ 0.6 may be granted as acceptable (Field 2009). All of 116 construct measures were above 0.6. There were a lot of alpha coefficients above 0.900.

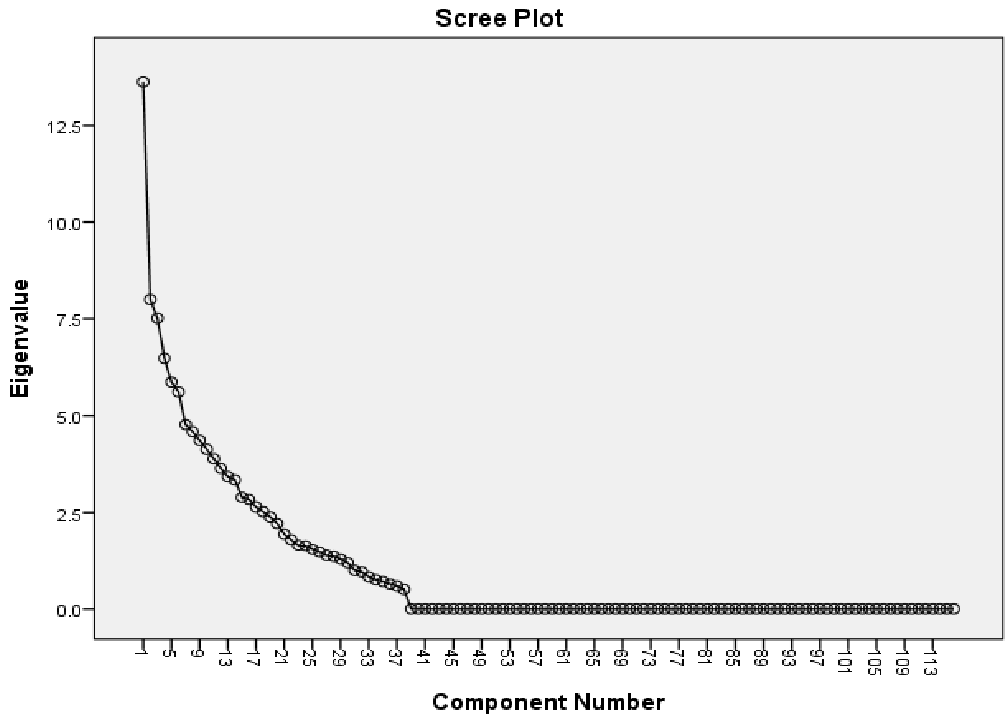
4.5.2 Exploratory Factor Analysis (EFA)

The EFAs were performed according to the model-building framework introduced by Hair et al. (2007) and Turker (2009). All EFAs were done on SPSS version 19. The results of EFAs assist in understanding latent constructs (Conway & Huffcutt, 2003).

One of the results from the EFA was the scree plot as shown in Figure 4.1 which was generated by SPSS version 19 statistical package. The scree plot provides the information about the number of factors to be retained, using the subjective analysis (Cattell 1966). Thus the single factor indicated unidimensionality of the items used in the scale, which enabled the further progress in the analysis required at scale level as well.

In the scree plot, each eigenvalue (Y-axis) is plotted against each factor (X-axis) which can show the importance of each factor. Typically, there will be a few factors with quite high eigenvalues, and many factors are with relatively low eigenvalues which gives a very characteristic shape (Cattell 1966). There is always a sharp descent in the curve followed by a tailing off shown in Figure 4.1. According to Cattell (1966), the cut-off point for selecting factors should be at the point of inflexion of the curve which is where the slope of the line changes dramatically. In Figure 4.1, thirty (30) factors from 116 were retained for further analysis. These thirty factors were also shown in Table 4.4 derived from Appendix E to K. The assigned codes for these 30 factors can be referred to Table 4.1. These 30 factors came from the constructs of entrepreneurial type (ET), market orientation (MO), business climate (BC), competitive advantages (CA), environmental uncertainty (EU), organisational strategy (OO) and types of innovation (TI) (entrepreneurial leadership capacity).

Figure 4.1 Scree plot for 116 components in the EELC model



From Appendix E to K, data were analysed through the principal component factor. The number of factors extracted was shown individually for each construct three. Table 4.4 shows the factor structure with eigenvalues greater than 1.0. The percentage of the variance and Alpha coefficients should also be studied for each factor. The total values for eigenvalues and percentage of the variance could be found in Table 4.4. Entrepreneurial type (ET) got higher total eigenvalues and percentage variance comparatively.

Table 4.4 Summary for eigenvalues, % variance and Alpha coefficient for 30 factors shown in Appendices E to K

Appendix E (ET)	**Construct/Factor**	**ETPA**	**ETSS**	**ETEI**	**ETRM**		**Total**
	Eigenvalues	10.024	5.667	5.486	5.283		26.46
	% of variance	8.641	4.886	4.729	4.554		22.81
	Alpha coefficient (α)	0.901	0.902	0.900	0.900		
Appendix F (MO)	**Construct/Factor**	**MOIC**	**MOEI**	**MOMR**	**MOGM**	**MOMS**	**Total**
	Eigenvalues	4.167	4.114	3.783	3.774	3.573	19.41
	% of variance	3.593	3.547	3.261	3.254	3.080	16.74
	Alpha coefficient (α)	0.902	0.901	0.901	0.902	0.900	
Appendix G (BC)	**Construct/Factor**	**BCPT**	**BCBE**	**BCCR**			**Total**
	Eigenvalues	3.518	3.489	3.482			10.49
	% of variance	3.033	3.008	3.001			9.04
	Alpha coefficient (α)	0.902	0.902	0.901			
Appendix H (CA)	**Construct/Factor**	**CAFC**	**CACP**	**CABE**	**CAPD**		**Total**
	Eigenvalues	3.407	3.406	3.372	3.331		13.52
	% of variance	2.937	2.937	2.906	2.872		11.65
	Alpha coefficient (α)	0.902	0.901	0.902	0.900		
Appendix I (EU)	**Construct/Factor**	**EUPI**	**EULI**	**EURI**	**EUSI**	**EUFI**	**Total**
	Eigenvalues/Factor	3.286	3.207	3.127	3.066	2.928	15.61
	% of variance	2.833	2.764	2.696	2.643	2.524	13.46
	Alpha coefficient (α)	0.900	0.900	0.900	0.901	0.901	
Appendix J (OO)	**Construct/Factor**	**OOLI**	**OOCI**	**OONC**	**OOMT**	**OORC**	**Total**
	Eigenvalues	2.888	2.835	2.756	2.720	2.716	13.92
	% of variance	2.489	2.444	2.376	2.345	2.341	12.00
	Alpha coefficient (α)	0.901	0.901	0.901	0.901	0.902	
Appendix K (TI)	**Construct/Factor**	**TINW**	**TIFP**	**TICM**	**TIEP**		**Total**
	Eigenvalues	2.706	2.661	2.658	2.594		10.62
	% of variance	2.333	2.294	2.291	2.236		9.15
	Alpha coefficient (α)	0.901	0.900	0.901	0.899		

4.6 Partial Least Squares Path Modeling (PLS-PM) for Structural Equation Modeling (SEM)

The detailed discussion of PLS-PM can be referred to Appendix V.

4.7 Chapter Summary

The chapter proceeds in the following sections for the study of new entrepreneurship (EELC) model: the research design, the development of survey questionnaires and research instruments, sample and data collection, the development of measurement model and Partial Least Squares Path Modeling (PLS-PM) for Structural Equation Modeling (SEM)**.**

This new model (EELC) was applied to study high-technology industry such as biotechnology, a science-based industry to simply validate its preliminary findings. The research design of the sample survey of the Australian biotechnology companies is based on quantitative methods (Gray 2009; Kraska 2010). In this research of an EELC model as shown in Figure 1.1, the independent variables are the entrepreneurial type (personal achiever (PA), super sales people (SS), expert idea generator (EI) and real manager (RM)), the external drivers (market orientation, business climate, environmental uncertainty and competitive advantages) and the internal driver (organisational strategy) while the dependent variables are the entrepreneurial process (presence of opportunity, opportunity recognition, decision for opportunity exploitation, resource acquisition, process management) and the enhanced organisational achievement (business models and enterprise performance). Independent variables will act on dependent variables only indirectly via intervening variable which is the entrepreneurial leadership capacity (types of innovation and; recognition of innovation barriers from financial, regulatory and resource perspectives) as the mediator.

In the development of the new model, a set of twenty-three (23) hypotheses were also structured to test the validity of this new model of entrepreneurship for high-technology ventures. Using thirty nine (39) high-technology firms as the sample size of the biotechnology industry, company visits were conducted by using structured survey questionnaire interviews. Their responses provide quantitative data to test the validity of this new model. Descriptive statistics are used to summarise the data in the analysis. Inferential statistics are applied to draw inferences from the sample chosen to a larger population that the sample is drawn from (Gray 2009).

After the survey was conducted, the data was prepared and analysed statistically with Partial Least Squares Path Modeling (PLS-PM) for Structural Equation Modeling (SEM).

CHAPTER 5 RESULTS, DATA ANALYSIS AND DISCUSSION

5.1 Chapter Introduction

This new model of entrepreneurship has been built and justified in Chapter 3. It was applied to high-technology industry such as biotechnology, a science-based industry to simply validate the model for its testing. In the cross-sectional study, structured questionnaire surveys were conducted.

This chapter describes the results, data analysis and discussion of the application of the EELC model in the biotechnology industry. Survey data acquired through questionnaire survey were analysed. First, the result section has a summary of the key demographics and the mean of the respondents was demonstrated. Then the major results from the questionnaire were summarised. Second, for the purpose of study the data were prepared and analysed statistically with Partial Least Squares Path Modeling (PLS-PM) for Structural Equation Modeling (SEM) as briefly described in the Section 4.6 of Chapter 4. Third, Section 5.3 details the data analysis section of the study of the new model of EELC. It discusses the results of the SEM-based Partial Least Squares (PLS) analysis of the quantitative data. The PLS framework was used to evaluate the measurement model for item reliability, internal consistency, internal consistency and discriminant validity. This is followed by the analysis of the structural model using a bootstrapping procedure to evaluate the significance of the paths (hypothesis testing) in the model and to measure the explained variance, R^2. Fourth, the discussion interprets the research model by analysing the twenty three (23) hypotheses testing in detail. Finally, it ends with a chapter summary.

5.2 Results

The survey questionnaire as shown in Appendix C comprises forty-five questions in three sections: company information, research model (entrepreneurial process for venture growth, entrepreneur, entrepreneurial leadership capacity, external and organisational drivers, and enhanced organisational achievement) and miscellaneous. Among the twenty-two questions in the first section, the key executive of the surveyed Australian biotechnology firms was asked to provide general company information, for example, the origin of the company (university spin-off or independent venture), distribution of revenue by sources, technology sector, major technology expertise, percentage of total expenditure spent on R&D expenses and reasons for company formation. In the second section, twenty questions were asked with reference to the new entrepreneurship model including an entrepreneurial process for venture growth, entrepreneur, entrepreneurial leadership capacity, external and organisational drivers, and enhanced organisational achievement. The last three questions were used to collect the information about the challenges faced by the high-technology venture and the feedback or comments on the survey. Most interviewees were asked to rank each factor with respect to the degree of importance based on the Likert scale of 1-5 (1=not important; 3=important; 5=extremely important).

As indicated in Chapter 4, the survey was conducted according to Figure 1.1 which describes the proposed new model of entrepreneurship (EELC) for high-technology ventures. After the survey, the data were prepared and analysed statistically with Partial Least Squares Path Modeling (PLS-PM) for Structural Equation Modeling (SEM).

In this study, the sample of biotechnology firms involved in the Australian study was drawn from the publicly-listed companies in the Australian Stock Exchange

(ASX) and the private companies documented in the Australian Biotechnology 2005 directory (AusBiotech 2005). Table 5.1 displays the population and sample sizes for the listed and private Australian biotechnology firms. From a total sampling base of 136 Australian Stock Exchange (ASX) biotechnology companies, a sub-sample of 81 (60%) dedicated biotechnology companies (DBCs) was selected for the survey. Forty (40) major private firms were chosen out of a base of 260 private biotech companies (15%). The total survey population size was 121 biotech firms across five states (New South Wales, Victoria, Queensland, South Australia and Western Australia) and the Australian Capital Territory. Tasmania and Northern Territory were not included in the survey due to their absence in the population set. The individual combined population size for each region were 35 (NSW), 38 (VIC), 20 (WA), 19 (QLD), 4 (SA) and 5 (ACT). The survey was conducted between November 2005 and March 2006.

The overall response rate for the survey of Australian ASX listed and private biotechnology companies was 32.2% (39/121) as shown in Table 5.1. The breakdown of individual response rate by region was 31.4% (11/35) for NSW, 29.0% (11/38) for VIC, 25.0% (5/20) for WA, 47.4% (9/19) for QLD and 75% (3/4) for SA. No biotechnology companies in the ACT were willing to participate in the survey. Overall, five questionnaires were returned by mail instead due to the unavailability of the key executives for surveys. Although the number of respondents to the survey was only 39 biotechnology firms which were small, the response rate was acceptable for this cross-sectional study. As discussed in Chapter 4, the sample size is still very representative of the population size. Both publicly-listed and private biotechnology firms were surveyed across five states in Australia. Besides, the Australian biotechnology industry is still in an early stage of development. The size of most biotechnology start-ups is not very big. On most occasions, those start-ups will only have one or two staff to start with, for example, the founder or the chief executive officer (CEO) and the secretary. It was extremely hard to get the agreement from the senior executive to commit their time to do a one hour face-to-face questionnaire survey. Thirty-nine (39) out of 121 biotechnology firms of population size was not a small sample size leading to 32.2% of response rate. This response rate was very satisfactory in an emerging industry like biotechnology with a small population size. The biotechnology industry is different from those popular high-technology industries such as information technology with huge population size for sampling in study.

Table 5.1 Response rate, population and sample size by state or region

State/ Region	**N-size**			**Population % by region**	**n-size**			**Sample % of n**	**Response rate by region**
	Listed	**Private**	**Total**		**Listed**	**Private**	**Total**		
NSW	24	11	35	**28.9%**	8	3	11	**28.2%**	**31.4%**
VIC	32	6	38	**31.4%**	10	1	11	**28.2%**	**29.0%**
WA	13	7	20	**16.5%**	4	1	5	**12.8%**	**25.0%**
QLD	7	12	19	**15.7%**	3	6	9	**23.1%**	**47.4%**
SA	4	0	4	**3.3%**	3	0	3	**7.7%**	**75%**
ACT	1	4	5	**4.2%**	0	0	0	**0%**	**0%**
Total	**81**	**40**	**121**	**100%**	**28**	**11**	**39**	**100%**	**32.2%**

Note: NSW = New South Wales
VIC = Victoria
WA = Western Australia
QLD = Queensland
SA = South Australia
ACT = Australian Capital Territory

Listed and private biotechnology companies were asked to identify their company origins (Question 7) into one of six categories: university spin-off (USO), government research institute/department spin-off (GRSO), industrial spin-off (ISO), corporate branch (CB), independent venture (IV) and private investor with a university collaborator (PI).

A USO firm can be defined as a new company which has a founder from university academia, or licenced technology from the university or the equity investment from a university (OECD 2001). Yencken (2002, p. 2) provides the general definitions for GRSO, ISO and PI. GRSO is a new company which

> "has been created in order to commercialise intellectual property arising out of a research provider organisation where IP is licensed, usually through a patent, from the research provider organisation to the new firm to form the founding IP of the firm, and usually involving staff transfer."

ISO is a new firm which

> "is set up by former or present parent company drawing on their experience acquired during their time at the parent company, but which have no formal IP licensing or similar relationships to the parent company."

PI is a new company in which

> "the private investors set up in collaboration to exploit commercially the university's tacit knowledge and know how, usually but not solely in the area of process rather than product innovation, where formally protected (e.g. patents) IP and/or exclusive licensing may not have been involved."

An IV company can be defined as a new firm which has no relationship or collaboration with any universities or any institutes but which generally has much greater initial access to resources than USO, GRSO, ISO and PI firms. CB is a new firm which is set up by the parent company as a subsidiary to represent the corporation in another city or country.

Table 5.2 provides the distribution of these six categories across the sample of Australian listed and private biotechnology firms. No corporate branches were surveyed. Out of the sample size of 39 biotech companies, the USO category had the highest number of companies of 14 while the IV, the second largest category, had 11 companies. The sample size for ISO was very small due to the limited number of companies present in the population.

Table 5.2 Origin of company for the surveyed Australian listed and private biotechnology firms

Origin of company	Listed biotech firms					Private biotech firms					Total no.
	NSW	VIC	WA	QLD	SA	NSW	VIC	WA	QLD	SA	
University spin-off	3	2	1		1	3			4		14
Govern. research institute/ department spin-off	1	3	2				1				7
Industrial spin-off		1							1		2
Corporate branch											0
Independent venture	3	3	1	2	1			1			11
Private investor + university collaboration	1	1		1	1				1		5
Other											0
Total no.	8	10	4	3	3	3	1	1	6	0	39

Note: NSW = New South Wales
VIC = Victoria
WA = Western Australia
QLD = Queensland
SA = South Australia
ACT = Australian Capital Territory

5.2.1Demographic Information for the surveyed Australian Biotechnology Firms

In the first section (Questions 1 to 22) of the survey questionnaire in Appendix C, twenty-two questions related to the industry or organisational characteristics were used to survey the key executive of biotechnology firms. Some tables concerning the origin of the company (university spin-off or independent venture) will be provided for further information. In the following section, surveyed results of general company information, for example, distribution of revenue by sources, technology sector, major technology expertise, percentage of total expenditure spent on R&D, expenses and reasons for company formation will be analysed and discussed.

Tables 5.3 and 5.4a summarise the company characteristics for the surveyed biotechnology firms. At the time the survey was conducted, the average age of company formation was around 7.3 years, ranging from 6.3 to 8.2 years. Out of the 39 surveyed Australian biotechnology firms, 28 firms (71.8%) were publicly-listed company while 11 firms (28.2%) were privately-owned. It is a very interesting phenomenon to observe such a high percentage of publicly-listed biotechnology firms in Australia. Because of insufficient funds for financing the early stage of venture present in the private sectors, most of the Australian biotechnology start-up ventures rely heavily on the funds raised in Initial Public Offerings (IPO) for research and development, or further issuing of public shares to the investors for future commercialisation. Due to the high costs of an IPO, and immature public listing in the stock exchange markets, the risks will be very high in biotechnology sectors. On the other hand, there are no joint-ventured, government-owned or university-owned biotechnology firms in the sample population.

Table 5.4a lists the results with respect to the various company origins (USO, IV, GRSO, PI and ISO) for company ownership, size of employment, total revenue, number of locations and overseas export activity (Questions 8, 9, 12, 14 and 15). In Question 9, over 90% (36 out of 39) of surveyed Australian-owned biotechnology firms have small scale operations (1-50 employees). As indicated in Table 5.2 the size of the operation was mostly up to 5 employees, which reflected the early stage of venture growth. As shown in Table 5.4a, 78% of surveyed biotechnology firms (28 out of 39) earned less than $A5 million in total revenue annually, which was considered low performance in revenue, while 15% of firms had zero annual revenue (Question 9).

Table 5.3 Company characteristics for the surveyed Australian biotechnology firms (Questions 4, 6 and 7)

Characteristic		Scores
Average age of company till 2006 (Q4)		Av: 7.3 years
Nature of company (Q6)	Publicly-listed company	28
	Private-owned company	11
	Government-owned company	0
	Joint-venture	0
	University-owned	0
	Other	0
Origin of company (Q7)	University spin-off (USO)	14
	Government research institute/department spin-off (GRSO)	7
	Industrial spin-off (ISO)	2
	Corporate branch (CB)	0
	Independent venture (IV)	11
	Private investor + university Collaboration (PI)	5
	Other	0

Table 5.4a Company characteristics for the surveyed Australian biotechnology firms (Questions 8, 9, 12, 14 & 15)

Characteristic	Scores		USO	IV	GRSO	PI	ISO
Company ownership (Q8)	Total: 33	a) Australian-owned	12	10	6	4	1
	0	b) Foreign-owned	0	0	0	0	0
	6	c) Combination of Australian and foreign owned	2	1	1	1	1
Size by employment in 2005 (Q9)	Total: 36	a) 1-50 employees	13	9	7	5	2
	2	b) 51-150 employee	1	1	0	0	0
	1	c) Over 150 or more employees	0	1	0	0	0
Total revenue in 2005 (Q12)	Total: 28	a) Less than A$ 5 million	10	6	7	5	0
	3	b) A$6-20 million	1	2	0	0	0
	1	c) A$21-50 million	0	1	0	0	0
	1	d) A$51-100 million	0	1	0	0	0
	0	e) A$101-200 million	0	0	0	0	0
	0	f) Over A$200 million	0	0	0	0	0
	6	g) Zero revenue	3	1	0	0	2
No. of locations in 2005 (Q14)	Total: 20	a) Single establishment	7	7	3	2	2
	19	b) Multiple locations	7	4	4	3	0
Overseas export activity (Q15)	Total: 12	a) Regular exporter	2	5	4	1	0
	10	b) Periodic exporter	5	2	1	2	0
	6	c) Non-exporter	2	2	1	1	0
	6	d) Future exporter	3	0	1	1	1
	5	e) Other (eg N/A)	2	2	0	0	1

Note: USO = University spin-off; GRSO = Government research institute/department spin-off ; ISO = Industrial spin-off ; IV = Independent venture ; PI = Private investor + university Collaboration

Table 5.4b lists the company characteristics for the surveyed Australian biotechnology firms including the stage of venture (start-up, early stage, expansion and maturity), position (founder, CEO or innovation manager etc.), and seniority (senior executive and middle manager) in company. Out of the 39 surveyed Australian biotechnology firms, there were 7 start-ups, 13 early stage firms, 10 expansion firms and 9 maturity firms. Among the surveyed personnel, there were 29 senior executives and 10 middle managers, who provided a good representation of the population size.

During the stage of data collection as shown in Table 5.4b, out of the 39 surveyed Australian biotechnology firms, there were 31 firms (79.5%) having face-to-face interviews, 5 firms (12.8%) completing email questionnaires and 3 firms (7.7%) having telephone interviews.

Table 5.4b Company characteristics for the surveyed Australian biotechnology firms (stage of venture, position and seniority in company)

Total no. of firms	Australian biotech firm	Origin of firm	No. of years formed	Stage of venture	Position in company	Seniority in company	Type of data collection
14	Firm 1 (NSW)	USO	5	Early stage	Founder/General Manager	Senior Executive	Face-to-face
	Firm 2 (NSW)	USO	5	Early stage	Founder/General Manager	Senior Executive	Face-to-face
	Firm 3 (NSW)	USO	6	Expansion	Chief Scientific Officer	Senior Executive	Email
	Firm 4 (VIC)	USO	7	Expansion	Founder/CEO	Senior Executive	Face-to-face
	Firm 5 (VIC)	USO	18	Maturity	Founder/General Manager	Senior Executive	Face-to-face
	Firm 6 (WA)	USO	5	Early stage	Project Manager	Middle Manager	Telephone
	Firm 7 (SA)	USO	20	Maturity	Business Development Manager	Middle Manager	Face-to-face
	Firm 8 (NSW)	USO	1.5	Start-up	Founder/CEO	Senior Executive	Face-to-face
	Firm 9 (NSW)	USO	2	Start-up	Founder/CEO	Senior Executive	Face-to-face
	Firm 10 (NSW)	USO	2	Start-up	Founder/CEO	Senior Executive	Face-to-face
	Firm 11 (QLD)	USO	5	Early stage	Business Development Manager	Middle Manager	Email
	Firm 12 (QLD)	USO	4	Early stage	Business Development Manager	Middle Manager	Face-to-face
	Firm 13 (QLD)	USO	6	Expansion	Founder/CEO	Senior Executive	Face-to-face
	Firm 14 (QLD)	USO	1	Start-up	Founder/CEO	Senior Executive	Face-to-face
11	Firm 15(NSW)	IV	21	Maturity	Founder/Chairman	Senior Executive	Face-to-face
	Firm 16 (NSW)	IV	21	Maturity	Founder/CEO	Senior Executive	Telephone
	Firm 17 (NSW)	IV	6	Expansion	Director	Senior Executive	Face-to-face
	Firm 18 (VIC)	IV	5	Early stage	Founder/CEO	Senior Executive	Face-to-face
	Firm 19 (VIC)	IV	4	Early stage	Founder/General Manager	Senior Executive	Face-to-face
	Firm 20 (VIC)	IV	19	Maturity	Business Development Director	Senior Executive	Email
	Firm 21 (WA)	IV	5	Early stage	Director	Senior Executive	Face-to-face
	Firm 22 (SA)	IV	20	Maturity	Innovation Manager	Middle Manager	Face-to-face
	Firm 23 (QLD)	IV	20	Maturity	Operation Manager	Middle Manager	Face-to-face
	Firm 24 (QLD)	IV	17	Maturity	VP Marketing	Senior Executive	Telephone
	Firm 25 (WA)	IV	4	Early stage	Director	Senior Executive	Face-to-face
7	Firm 26 (NSW)	GRSO	5	Early stage	Founder/CEO	Senior Executive	Face-to-face
	Firm 27 (VIC)	GRSO	17	Maturity	R&D Director	Senior Executive	Face-to-face
	Firm 28 (VIC)	GRSO	4	Early stage	Business Development Manager	Middle Manager	Face-to-face
	Firm 29 (VIC)	GRSO	1.5	Start-up	Founder/CEO	Senior Executive	Face-to-face
	Firm 30 (WA)	GRSO	6	Expansion	Director	Senior Executive	Face-to-face
	Firm 31 (WA)	GRSO	4	Early stage	Business Development Director	Senior Executive	Face-to-face
	Firm 32 (VIC)	GRSO	2	Start-up	Founder/CEO	Senior Executive	Eamil
5	Firm 33 (NSW)	PI	7	Expansion	Innovation Manager	Middle Manager	Face-to-face
	Firm 34 (VIC)	PI	8	Expansion	Business Development Manager	Middle Manager	Face-to-face
	Firm 35 (SA)	PI	9	Expansion	Chief Financial Officer	Senior Executive	Email
	Firm 36 (QLD)	PI	4	Early stage	Business Development Manager	Middle Manager	Face-to-face
	Firm 37 (QLD)	PI	6	Expansion	Chief Financial Officer	Senior Executive	Face-to-face
2	Firm 38 (VIC)	ISO	1.5	Start-up	Founder/CEO	Senior Executive	Face-to-face
	Firm 39 (QLD)	ISO	6	Expansion	Chief Financial Officer	Senior Executive	Face-to-face

Note: USO = University spin-off
GRSO = Government research institute/dept. spin-off
ISO = Industrial spin-off
CB = Corporate branch
IV = Independent venture
PI = Private investor + uni. Collaboration

Table 5.5 lists the results for employment by function, geographic sources of revenues and percentage revenue by sources (Questions 10, 11 and 13). Since the biotechnology industry is a high-technology sector, R&D of innovative products remains the top priority for competitive edge which is demonstrated very clearly by the average of 57% of employees employed in R&D roles and the average of

7.9% employed in manufacturing roles. In Table 5.5, the distribution of the top 4 rankings by percentage of revenue by sources is as follows: contract/collaboration (20.2%), product sales (18.5%), royalty or licensing (15.7%) and government grants or loans (15.5%). Although many firms referred to the importance of product selling during the surveys, a large proportion of firms did not have physical products for sale. In the distribution of revenue by sources, a lot of surveyed biotechnology firms relied on the high revenue of royalty/licensing fees generated from the granting of intellectual property (IP) rights of the third party, for example, new products, new research and development, and manufacturing processes.

Table 5.5 Distribution of employment by function, distribution of revenue by sources and by geographical sources for the surveyed Australian biotechnology firms (Questions 10, 13 & 11)

Total no. of firms	Distribution of employment (%) by function in 2005					Distribution of revenue (%) by sources in 2005									Distribution of revenue (%) in 2005 (geog.)				
	R & D	Finance	Manufacturing	Marketing & sales	General management	Product sales	Royalty/licensing	Contract/collaboration	Interest revenue	Agreement with big firm	Govt. grants/ loans	R & D	Shareholders	Other (eg No revenue)	Within capital city	Within same state	Elsewhere in Aust.	Outside Australia	Other (eg N/A)
39	**57**	**9.9**	**7.9**	**8.9**	**16.7**	**18.5**	**15.7**	**20.2**	**5.5**	**0**	**15.5**	**3.3**	**4**	**0**	**15.6**	**7.1**	**15.6**	**45.1**	**0**

Table 5.6 Percentage of total expenditure on R&D and marketing or distribution expense, percentage of sales from new products, estimated time to revenue and reason for company formation for the surveyed Australian biotechnology firms (Questions 17-20 and 22)

Total no. of firms	% Total expenditure on R& D in 2005	% Total expenditure on marketing/distribution expense in 2005	% Sales from new products in 2005	Estimated time to revenue						Reason[1] for company formation						
				1 – 2 years	3 – 5 years	5 – 10 years	10 – 15 years	Over 15 years	Now	Simply commercial potential and benefit	Corporate branch	Aim for building a large life science company	Tax/legal liability/regulatory reasons	Future commercialisation potential	Reward/remuneration for staff	Make money
39	**Av: 54.5**	**8.1**	**20.2**	**Total: 13**	**10**	**2**	**0**	**1**	**14**	**Total: 21**	**0**	**10**	**0**	**13**	**1**	**1**

Table 5.6 indicates the percentage of total expenditure on R&D and marketing/distribution expense, the percentage of sales from new products, estimated time to revenue and reason for company formation for the surveyed Australian biotechnology firms. Some surveyed biotechnology firms had more than 50% of total expenditure on R&D and more than 25% sales from new products.

In Table 5.6, the average percentage of total expenditure on marketing/distribution expense was around 8%, ranging from 6.6% to 10.3%. Some survey firms had immediate ("now") revenue generated from businesses while the conditions for other biotechnology firms were not that favourable. Most of the surveyed firms estimated their companies would have revenues within one to two years. The top three reasons for company formation were given as simply commercial potential and benefit, future commercialisation potential and the aim of building a large life science company (Table 5.6).

Technology sector and major technology expertise

It is important to understand which technology sector (Tables 5.7 and 5.8) and major technology expertise (Tables 5.9 and 5.10) those surveyed biotechnology firms come from. Table 5.7 lists the overall composition of technology sectors in general, while Table 5.8 describes the company origins for the surveyed Australian biotechnology firms. The technology sectors being examined were human therapeutics, agriculture, medical diagnostics, suppliers, chemical and environment, bioinformatics, medical devices, animal health and research tools/diagnostics.

Table 5.7 Technology sector for the surveyed Australian biotechnology firms (Question 16)

	%
Human therapeutics	54.90
Agricultural biotechnology	5.88
Medical diagnostics	9.80
Suppliers	1.96
Chemical, environment etc	5.88
Bioinformatics	3.92
Medical devices	7.84
Animal health	7.84
Research tools/diagnostics	1.96
[1]Total no.	100

Note: [1]A lot of surveyed companies claimed to have several technology sectors expertise.

From the survey results, human therapeutics sector is the dominant technology sector across the company origins as shown in Table 5.8. The USO biotechnology firms have the widest spread across technology sectors among the other four groups while IV is the second group with this trend. Human therapeutics sector was the biggest sector out of 51 sampled technology sectors (54.9%).

Table 5.8 Company origin and technology sector for the surveyed Australian biotechnology firms (Question 16)

	USO	IV	GRSO	PI	ISO	[1]Total no.	%
Human therapeutics	9	8	6	3	2	28	54.90
Agricultural biotechnology	2	1				3	5.88
Medical diagnostics	2	3				5	9.80
Suppliers			1			1	1.96
Chemical, environment etc.	1		2			3	5.88
Bioinformatics	1	1				2	3.92
Medical devices	1	1	1	1		4	7.84
Animal health	2	2				4	7.84
Research tools/diagnostics	1					1	1.96
[1]Total no.	19	16	10	4	2	51	100

Note: [1]A lot of surveyed biotechnology companies claimed to have several major technology expertise;
USO = University spin-off; GRSO = Government research institute/department spin-off;
ISO = Industrial spin-off ; IV = Independent venture;
PI = Private investor + university collaboration

Table 5.9 Major technology expertise for the surveyed Australian biotechnology firms (Question 21)

	[1]Total no.
a) Genomics	1
b) Lead compound identification/screening/targets	8
c) Diagnostics	5
d) Services	2
e) Delivery mechanisms	6
f) Bioinformatics	3
g) Biomaterials/bioactives	3
h) Platform technologies	11
i) Tissue engineering	3
j) Proteomics	6
k) Libraries/databases	4
l) Medical devices	7
m) DNA therapy	2
n) Therapeutic antibody	5
o) Cell therapy	6
p) Diagnostic antibody	3
q) Gene therapy	3
r) Bioprospecting	0
s) Nanotechnology	2
t) Drug delivery/pharmaceutical processing	4
u) Enzymes & expression	4
v) Probiotics	1
w) Oncology/therapeutic virus	3
x) Product development	8
y) Vaccines/peptides	3
z) Drug development	1
[1]Total no.	104

Note: [1]A lot of surveyed companies claimed to have several major technology expertise.

Table 5.10 Company origin and major technology expertise for the surveyed Australian biotechnology firms (Question 21)

	USO	IV	GRSO	PI	ISO	CB	[1]Total no.
a) Genomics				1			1
b) Lead compound identification/ screening/targets	1	2	2	2	1		8
c) Diagnostics	2	2		1			5
d) Services		1	1				2
e) Delivery mechanisms	3	2		1			6
f) Bioinformatics	2	1					3
g) Biomaterials/bioactives	1		1	1			3
h) Platform technologies	3	3	2	3			11
i) Tissue engineering			2	1			3
j) Proteomics	3	2	1				6
k) Libraries/databases	1	1	2				4
l) Medical devices	3	1	2	1			7
m) DNA therapy	1			1			2
n) Therapeutic antibody		2	3				5
o) Cell therapy	2		3	1			6
p) Diagnostic antibody		2	1				3
q) Gene therapy	2		1				3
r) Bioprospecting							0
s) Nanotechnology	1		1				2
t) Drug delivery/ pharmaceutical processing	2	1		1			4
u) Enzymes & expression	2	1		1			4
v) Probiotics				1			1
w) Oncology/therapeutic virus	1	1		1			3
x) Product development	3	3		2			8
y) Vaccines/peptides	2	1					3
z) Drug development					1		1
[1]Total no.	35	26	23	18	2		104

Note: [1]A lot of surveyed companies claimed to have several major technology expertise.
USO = University spin-off
GRSO = Government research institute/department spin-off
ISO = Industrial spin-off
CB = Corporate branch
IV = Independent venture
PI = Private investor + university collaboration

In Tables 5.7 and 5.8, the second-largest technology sector was medical diagnostics (9.8%), while the third group consisted of medical devices (7.8%) and animal health (7.8%). These findings concur with the analysis done by Hopper and Thorburn (2005). Some biotechnology firms claim to specialise in several technology sectors.

In Tables 5.9 and 5.10, the major technology expertise areas were genomics, lead compound identification/screening/targets, diagnostics, services, delivery mechanisms, bioinformatics, biomaterials/bioactives, platform technologies, tissue engineering, proteomics, libraries/databases, medical devices, DNA therapy, therapeutic antibody, cell therapy, diagnostic antibody, gene therapy, bioprospecting, nanotechnology, drug delivery/pharmaceutical processing, enzymes and expression, probiotics, oncology/therapeutic virus, product development, vaccines/peptides and drug development. Some biotechnology firms had several areas of major technology expertise as shown in Tables 5.9 and 5.10. Alternatively, Table 5.11, which is the same table of Table 5.9 or Table 5.10, is presented in another format by listed and private companies. However, the dominating major technology expertise in biotechnology firms were platform technologies, lead compound identification/screening/targets, product development and medical devices as listed in Figure 5.1. The USO biotechnology firms had a range of technology expertise areas while the IV firms were in the second ranking. However, there were slightly more product development biotechnology firms in the IV than in the USO group.

Figure 5.1Major technology expertise and company origin the surveyed Australian listed and private biotechnology firms

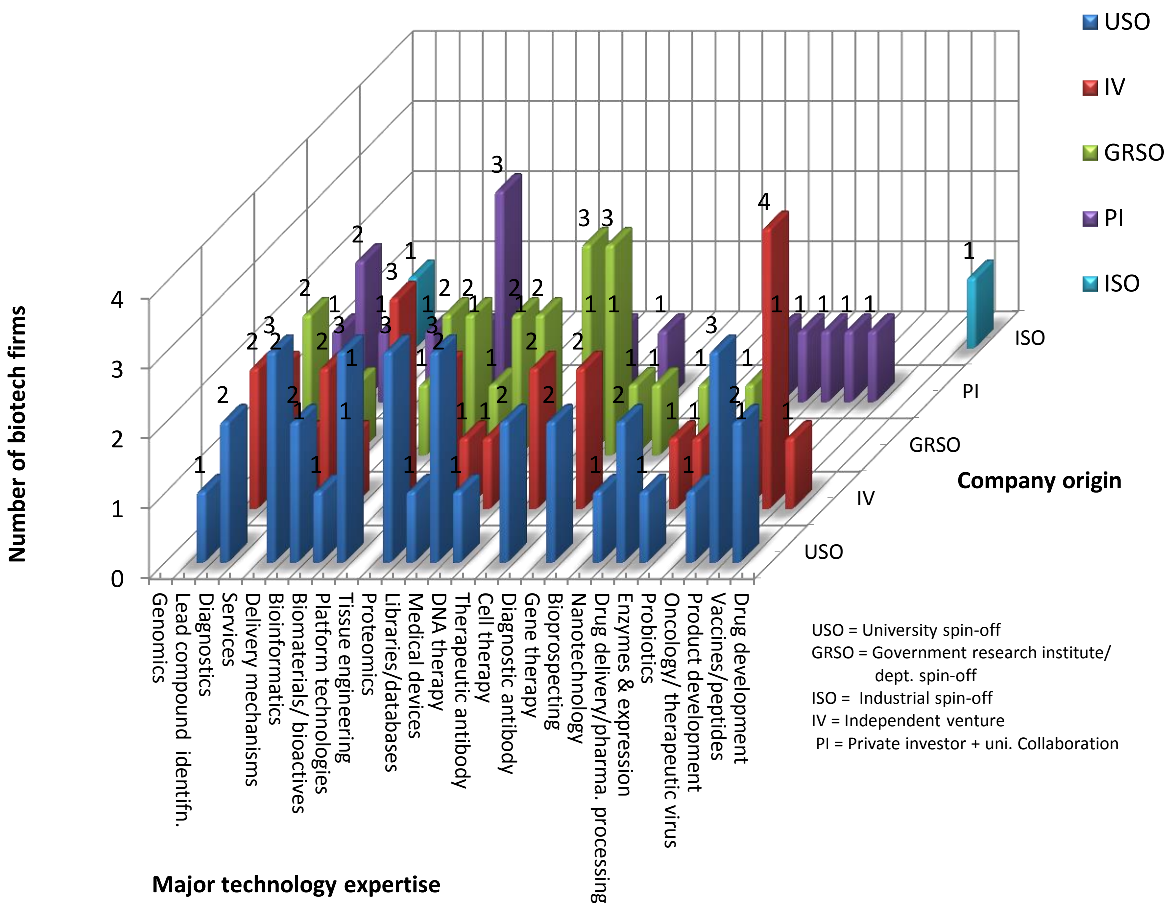


Table 5.11 Major technology expertise for the surveyed Australian listed and private biotechnology companies (Question 21)

	Listed biotech firms by technology					Private biotech firms by technology					Total no.
	NSW	VIC	WA	QLD	SA	NSW	VIC	WA	QLD	SA	
a) Genomics					1						1
b) Lead compound identification/ screening/targets	2	3	1		1				1		8
c) Diagnostics	2			1	1	1					5
d) Services		1			1						2
e) Delivery mechanisms		3	1		1				1		6
f) Bioinformatics	3										3
g) Biomaterials/ bioactives				1	1		1				3
h) Platform technologies	2	4	1	2					2		11
i) Tissue engineering			1	1			1				3
j) Proteomics	1	1	1			1		1	1		6
k) Libraries/databases	2	1	1								4
l) Medical devices	1	1	2	1		1			1		7
m) DNA therapy		1							1		2
n) Therapeutic antibody	2	2					1				5
o) Cell therapy		2	1	1			1		1		6
p) Diagnostic antibody	2			1							3
q) Gene therapy							1		2		3
r) Bioprospecting											0
s) Nanotechnology	1	1									2
t) Drug delivery/ pharmaceutical processing	1	1		1					1		4
u) Enzymes & expression				2		1			1		4
v) Probiotics	1										1
w) Oncology/ therapeutic virus	1	1							1		3
x) Product development		3		3					2		8
y) Vaccines/peptides		1		1					1		3
z) Drug development		1									1
[1]Total no.	21	27	9	15	6	4	5	1	16	0	104

Note: NSW = New South Wales, Australia
VIC = Victoria, Australia
WA = Western Australia, Australia
QLD = Queensland, Australia
SA = South Australia, Australia

5.2.2 Summary for Major Results

Entrepreneurial Type

In this study, Table 5.12 describes the entrepreneurial types (personal achiever (PA), expert idea generator (EI), super sales people (SS) and real manager (RM)) and the identity of the entrepreneurs present in the firm (founder, CEO or inventor), and the importance rating for entrepreneurial type to the surveyed biotechnology firms. The interviewees of the sample biotechnology firms had to identify the entrepreneurs present in their companies (Table 5.12). The personal achiever (PA) and the expert idea generator (EI) entrepreneurs were still the top two most easily found entrepreneurial types in the biotechnology industry compared to the last two types: the real manager (RM) and super sales people (SS) entrepreneurs. Generally, the PA and EI entrepreneurs, who were mostly the company founders or the technology inventors, were easily found in a high-technology industry like biotechnology. Since the biotechnology industry is very technology-oriented, which requires a lot of innovative products and new inventions, these PA and EI entrepreneurs need to have considerable persistence and self-determination with motivation to drive the ideas to the commercialisation of products.

In the majority of cases, the CEO, inventor/founder and scientific/technical director were nominated as the entrepreneurs in the company among the six origin groups (university spin-off (USO), government research institute/department spin-off (GRSO), industrial spin-off (ISO), corporate branch (CB), independent venture (IV) and private investor with a university collaborator (PI)). The government research institute/department spin-off (GRSO) and industrial spin-off (ISO) biotechnology firms perceived the CEO as the dominant entrepreneur in the company. However, the university spin-off (USO) group considered the chairman of the board as the major entrepreneur while the independent venture (IV) chose the scientific/technical director and private investor with university collaboration (PI) for administrative director/manager. Some key executives from the USO, IV and PI groups also suggested that the major shareholders investing in their companies should be classified as the entrepreneurs too.

Table 5.13 lists the most appropriate entrepreneurial type in the biotechnology industry. Received comments from several senior managers or chief executive officers (CEOs) during the survey of Australian biotechnology firms indicated that there is thought to be a high failure rate for those biotechnology ventures having a scientist or inventor or company founder as the company CEO. These "scientist founders" like PA and EI do not always have sufficient commercial experience running a company. Clearly, running a commercial biotechnology firm is quite different from leading a research team in a university. It should be noted that the "scientist founders" of Cochlear, ResMed and Alchemia are exceptions in the Australian biotechnology industry. These are reasons why the biotechnology industry needs more super sales people (SS) and real manager (RM) entrepreneurs who can understand the customers' needs, to market their technologies or products successfully.

From the findings of this study, although there are more EI entrepreneurs in the university spin-off (USO) biotechnology firms, the personal achiever entrepreneur was rated as the most important. All PA, EI and RM entrepreneurs present in the USO biotechnology firms were significantly different to SS entrepreneurs. Because of their university background as researchers, the PA and EI entrepreneurs may be able to negotiate a special agreement with the university to form a spin-off biotechnology firm to raise seed capital in order to commercialise their research inventions via the establishment of a university incubator. Some EI entrepreneurs may have a lot of innovative ideas and inventions but they may not be able to work as a PA entrepreneur due to their academic and technical backgrounds and personality traits. This may explain why there are not many SS entrepreneurs in the USO biotechnology group due to the dominant presence of PA and EI entrepreneurs from university researchers. Alternatively, it may be that these ventures are all at an earlier stage of development than those in the other groups.

Entrepreneurial Leadership Capacity

Research and Development

Biotechnology industry relies heavily on research and development (R&D) for competitive advantages. Good outcomes from R&D can lead to the invention of new innovative products. Table 5.14 displays the situation of R&D for innovation types in the Australian biotechnology industry. The types of innovation for R&D are outlined in Table 5.14. The innovation type for R&D (Q28) rated by most entrepreneurs was a new application of an existing product or service, including application to a new market segment.

Table 5.12 Entrepreneurial type, the identity and importance of entrepreneurial type for the surveyed Australian biotechnology firms (Questions 26, 25 and 24)

Total no. of firms		Entrepreneur type in your firm				Who is the entrepreneur in your biotechnology firm?							Importance rating for entrepreneur types.			
		Personal achievers	'Super' sales people	Expert idea generators	Real manager	Inventor/ founder	Chairman of board	CEO	Admin. director/ manager	Scientific/ technical director	Business dev. Manager	Major share-holder	Personal achievers	'Super' sales people	Expert idea generators	Real manager
39	**Total number**	**32**	**14**	**29**	**21**	**23**	**10**	**29**	**6**	**21**	**9**	**5**	**Average.: 4.2**	**3.7**	**3.8**	**3.7**

Note: PA = Personal achiever; SS = Super sale people; RM = Real manager; EI = Expert idea generator

Table 5.13 Summary for the most appropriate entrepreneurial type for the surveyed Australian biotechnology firms (Question 27)

Total no. of firms	[1]Most appropriate entrepreneur in industry			
	Personal achiever	'Super' sales people	Expert idea generator	Real manager
39	**2.2**	**3**	**1.9**	**2.7**

Note: PA = Personal achiever; SS = Super sale people; RM = Real manager; EI = Expert idea generator
[1] Appropriateness rating: 1=the most appropriate type; 2= appropriate type; 3=the less most inappropriate type; 4= the most inappropriate type.

Table 5.14 Innovation type (research and development) for the surveyed Australian biotechnology firms (Question 28)

Total no. of firms		Innovation type																	Average
		New to the world product or service	New to the firm product or service in line that at least one competitor is offering	New to the country and/or market product or service	New application of existing product or service, including application to a new market segment	Addition to a company's existing product or service line	Repositioning of an existing product or service	Product/service improvement, revision, including application of new feature or option or change	New administrative system or procedure	New production method	New marketing or sales approach	New customer support program	New logistical approach	New pricing approach	New distribution channel or method	New financing method	New purchasing technique	New organisational form or structure	
39	**Av. number**	**3.9**	**2.6**	**2.9**	**2.7**	**2.6**	**2.2**	**2.8**	**1.8**	**2.8**	**2.4**	**2.3**	**2.1**	**2.4**	**2.4**	**2.3**	**1.9**	**2**	**2.5**

Note: PA = Personal achiever
SS = Super sale people
RM = Real manager
EI = Expert idea generator
Importance rating: 1=Not important; 2=Less important; 3=Important; 4=Very important and 5=Extremely important

The last part of Table 5.15 lists the details of the innovation types with market launch time for all entrepreneurial types (PA, EI, SS and RM). PA and EI entrepreneurs have a lot of innovation types for R&D with short market launch time which makes PA and EI entrepreneurs favoured in leading with entrepreneurial leadership ability/capacity in competition when compared to SS and RM entrepreneurs.

Creativity and Innovation

Entrepreneurial leadership can stimulate the creativity of entrepreneurial team members, which can improve a new venture's innovative capability (Chen 2007). High technology firms in the biotechnology industry cannot have innovation without creativity. The major characteristic of the entrepreneur is the generation of a creative or innovative idea that can be of commercial value by inventing and developing new products or services through commercialisation. According to Schumpeter's (1934) theory, an act of will is required for successful innovation but not of intellect. This act of will is referring to leadership which is very similar to creativity in the chain process model (Schaper & Volery 2007). It shows that innovation depends, therefore, on leadership, not intelligence. From this it implies that leadership can lead to innovation and innovation leads to entrepreneurship. This demonstrates very clearly that entrepreneurial leadership capacity is a key determining factor having an influencing or mediating role between entrepreneurial types (personal achiever (PA), expert idea generator (EI), super sales people (SS) and real manager (RM)) and the success in entrepreneurial start-ups for new high-technology ventures.

The first part of Table 5.15 displays the survey results for creativity and innovation through the number of cases of innovation (Question 30) while the first part of Table 5.16 shows their results through the number of deals in operation

(Question 32). In Table 5.15, the ascending order for the top four total number of cases for innovation (creativity and innovation) past five years for all four entrepreneurial types is the following: the filed international patent applications (total=764), the received pending/ approval of international patents by another country (total=528), the filed Australia patent applications (total=526) and the received Australia patent approvals (total=480). Getting the filings or approvals from local and international patents is a critical stage in demonstrating creativity and innovation for all entrepreneurial types. As a result, much resourcing and effort will be invested in achieving these milestones of patent approvals. The higher the number of patents obtained, the higher degree of success that biotechnology firm has achieved.

Overall, the ascending order by entrepreneurial type of the total number of cases of innovation (creativity and innovation) past five years was PA (total=1617), EI (total=442), RM (total=182) and SS (total=104) (Table 5.15). Both SS and RM entrepreneurs, who may lack the technical expertise for innovations, are good at working with investors to secure the investment funding for further company expansion and design better business plans in marketing and management strategies. However, they may not be as good as the dominant presence of PA and EI entrepreneurs working as the company founders or inventors who have the scientific or academic background for creativity and innovation of new products.

The first part of Table 5.16 lists the number of deals of the six types (licensing, joint venture, alliance, merger, acquisition and investment). In general, all of the four entrepreneurial types (personal achiever (PA), expert idea generator (EI), super sales people (SS) and real manager (RM)) rated licensing as the most popular deal in the operation of a biotechnology firm. Alliance and joint venture were the next two popular types of deals.

Knowledge management

It is not just important for biotechnology firms to possess knowledge they need, but also they need to have the capabilities of managing the knowledge that comes from their intellectual property such as copyright, patents or inventions (Hemlin 2006). For the few organisations that can capture the collective wisdom of employees effectively, the leadership role becomes inevitably crucial to managing knowledge systematically. This is why it is so critical for entrepreneurs with entrepreneurial leadership ability to provide the organisational environment or culture for knowledge management (KM) in particular, in today's knowledge economy.

Table 5.15 Entrepreneurial type, number of cases of innovation (creativity/innovation), innovation type with launch time (research and development) for the surveyed Australian biotechnology firms (Questions 30 and 29)

Total no. of firms	Entrep. Type	Total no. of cases of innovation past five years								Total no. of cases per type	Innovation
		Australia patent applications filed	International patent applications filed	Australia patent approvals received	International patent pending/approvals by other country received	New products introduced	New processes introduced	Redesigned products	Redesigned processes		All innovation types held by firms in each entrepreneurial type (Time for market launch)
16	PA	382	494	329	358	37	7	6	4	**1617**	1. Enzymes for specific industrial applications (2 yrs)
											1.Product 1 (Launched); 2.Product 2 (Launched) 3.Product 3 (Launched); 4. 2.Product 4 (Launched)
											1.Product (2 yrs)
											1.New product (min. 2-3 yrs)
											1.Slow release drugs (1 yr); 2.Therapeutic antibodies (5 yrs); 3.Cancer therapy (7 yrs)
											1.Antibody-linked drugs in inflammation & oncology (8 yrs-2014)
											1.Oral delivery (3 yrs)
											1.Drug delivery (3-5 yrs) 2.Formulation service (Launched already)
											1. High volume and low cost products (0.5-1 yr)
											1.Diagnostic testing (1yrs)
											1.Product improvement (< 1 year); 2.New services (1 yr); 3.New product (1 yr)
											1.New products (3-7 yrs)
											1.New service (Launched now)
											NR
											1. New device (cardiograph diagnostic device) (3 yrs); 2.New device (lymphoedema) (<1 yr); 3.New rental agreement (<1 yr)
											1. New product (3 yrs)
10	EI	99	117	38	150	17	15	0	6	**442**	1.Process (5 yrs); 2. Product (5 yrs)
											1. New process (N/A); 2.New idea (5-7yrs); 3.New drug (5-15 yrs) 4.New diagnostic (3-5 yrs); 5.New method
											1.Cell therapy product 1 (2yrs); 2.Cell therapy product 2 (3yrs)
											1.New product (3 yrs); 2.Modified product (1 yr)
											1.New production process (1 yr); 2.New product (2-3 yrs) 3.New applications (1-2 yrs)

											1 New product (current); 2. Version 2 new product (1 yr)
											1.New product 1 (autologous cell therapies) (1 yr) 2. New product 2 (Medical device) (2 yrs) 3.Product improvement (2 yrs)
											1.Molecular delivery (>5 yrs); 2.New clinical applications (1-2 yrs)
											1.New product (>5 yrs)
											1.New product (immune system improvement) (5-10 yrs)
5	SS	12	23	10	14	11	9	15	10	**104**	1. New product (2-3 yrs); 2. New process (1 yr)
											1.Product improvement (Each quarter); 2.Addition to product service line (0.5 yr) 3.New to world product (5-7 yrs); 4 .New to firm product or service line (0.5 yr)
											1.Public capital (IPO) 2.Technology deals (Collaborative agreements) 3.Product licensing income (Licensing agreement) 4.Government (Govt application) 5.New product opportunities(in-licensing) 6.People (advertising)
											1.New to the world product (Launched already)
											1.New technology (4 yrs); 2.New product (1 yr)
8	RM	33	130	3	6	7	2	1	0	**182**	1.Patent-preferred drug products (2 yrs)
											1.New product (PROM TEST for pregnancy related) (2 yrs) 2.New product (Pre-Eclampsic test for pregnancy related) (2 yrs) 3.Upgrade of current test (Twin test) (2 yrs)
											1.New product (8 yrs)
											1. 4 New vaccines (10-15 yrs); 2. Manufactur-ing technologies (2-3 yrs)
											1.New product, CV-A21 (>5 yrs); 2.New product (>7 yrs)
											1.New to the world products (4-5 yrs)
											1.New method of drug development (2yrs-now ready) 2.New drug candidate (0.5-1yr)
											1.Biodegradable product (3 yrs) 2.Biodegradable orthopaedic products (3 yrs) 3.Wounds/ burns products (2yrs) 4.Cell delivery (3 yrs) 5.Tissues therapy (5 yrs) 6.Regenerative medicines (>5 yrs)
39	**Grand total number**	**526**	**764**	**380**	**528**	**72**	**33**	**22**	**20**	**2345**	

Note: PA = Personal achiever
SS = Super sale people
RM = Real manager
EI = Expert idea generator
NR = Not released. It will not be used for calculation and will be treated as 'zero' in interpretation

Table 5.16 Number of deals (creativity/innovation), number of cases or families for intellectual property (IP) and overall IP protection rating (knowledge management) for the surveyed Australian biotechnology firms (Questions 32, 33 and 34)

Total no. of firms		No. of deals in 2005								No. of IP Cases/ Families In 2005								Rating for company IP position				
		Licensing	Joint venture	Alliance	Merger	Acquisition	Investment	Not applicable	**Total**	Patents only	Trade marks only	Patents + trade marks	Copyright	Design registration	Trade secrets only	Patents + trade secrets	**Total**	Extremely robust	Strong	Fairy strong	Arguable	Weak
39	**Total number**	**27**	**12**	**21**	**2**	**9**	**7**	**5**	**83**	**60**	**5**	**206**	**4**	**5**	**11**	**423**	**714**	**13**	**16**	**6**	**4**	**0**

Note: PA = Personal achiever
SS = Super sale people
RM = Real manager
EI = Expert idea generator

Table 5.17 Type of financial, regulatory and resource barriers to innovation for the surveyed Australian biotechnology firms (Question 31)

Total no. of firms		Type of financial barriers to innovation						Type of regulatory barriers to innovation						Type of resource barriers to innovation					
		Lack of venture capital in early stage of venture	Lack of public funds in early stage of venture	Lack of government research funds in early stage of venture	Lack of venture capital in late stage of venture	Lack of public funds in late stage of venture	Lack of government research funds in late stage of venture	Australian government regulations (eg state or federal)	Foreign government regulations (eg CE/EMEA approval etc)	Australian patent process	Foreign patent process	TGA approval process	FDA approval process	Lack of skilled managers	Lack of skilled researchers	Lack of research facilities/assets	Lack of manufacturing facilities	Lack of marketing/distribution channels	Lack of clinical trial facilities
39	**Av. number**	**3.8**	**3.3**	**3.2**	**3.5**	**3.9**	**3.1**	**2.8**	**3.4**	**2.5**	**2.8**	**3**	**3.6**	**3.7**	**3.3**	**2.9**	**3**	**2.8**	**2.5**

Note: PA = Personal achiever
SS = Super sale people
RM = Real manager
EI = Expert idea generator
Level of barrier rating: 1=Major barrier; 2=Less barrier; 3=Barrier; 4=Medium barrier and 5=Major barrier

Knowledge management (KM) and innovation are the key processes for creating, exploiting, renewing and applying knowledge in new ways for improving organisational performance (Newman 2006; Hemlin 2006). Leadership style or ability such as transformational leadership or entrepreneurial leadership which can stimulate knowledge, creativity and innovation, generates advantages for organisational performance (Lu, Tsang & Peng 2008). Entrepreneurs who have the entrepreneurial leadership ability/capacity will have high potential for success in the achievement of organisational excellence (Darling, Gabrielsson & Seristo 2007). Also, entrepreneurial types (personal achiever (PA), expert idea generator (EI), super sales people (SS) and real manager (RM)) with entrepreneurial leadership ability/capacity should also promote team cohesion and allow the organisation to learn through communication, dialogue, experimentation or the process of organisational knowledge creation.

The middle part of Table 5.16 displays the survey results for knowledge management through the number of intellectual property (IP) cases or families for protection (Question 33) while the last part of Table 5.16 shows their results through the overall IP protection position (Question 34).

In the middle part of Table 5.16, the ascending order for the top three total number of IP cases or families for protection (knowledge management) for all four entrepreneurial types is: patents and trade secrets (total=423), patents and trademarks (total=206) and patents only (total=60).

In the last part of Table 5.16, the ascending order for the top two overall IP protection position (knowledge management) for all four entrepreneurial types (personal achiever (PA), expert idea generator (EI), super sales people (SS) and real manager (RM)) is: strong (total no. of firms=16) and extremely robust (total no. of firms=13).

Barriers to entrepreneurial leadership capacity

Table 5.17 lists entrepreneurial types, type of financial, regulatory and resource barriers to innovation for the surveyed Australian biotechnology firms. The financial, regulatory and resource barriers to innovation can also be the barriers to entrepreneurial leadership ability because without innovation it is hard to demonstrate entrepreneurial leadership ability in biotechnology ventures. By removing these barriers to innovation, it will provide a more favourable environment for the entrepreneurial types with entrepreneurial leadership ability to pursue modes of opportunity exploitation for biotechnology ventures. Of the financial barriers to innovation, the ascending order is: lack of public funds in late stage of venture (mean=3.9), lack of venture capital in early stage of venture (mean=3.8) and lack of venture capital in late stage of venture (mean=3.5) (Table 5.17). In the case of regulatory barriers, the ascending order was: FDA approval process (mean=3.6), foreign government regulations (e.g. CE/EMEA approval) (mean=3.4) and Australian approval process (e.g. TGA) (mean=3.0), while the order for resource barriers was a lack of skilled managers (mean=3.7), lack of skilled researchers (mean=3.3) and lack of manufacturing facilities (mean=3.0).

In summary, a strong entrepreneurial leader can make an organisation become more entrepreneurial as a whole. Entrepreneurial types (e.g. personal achiever (PA), expert idea generator (EI), super sales people (SS) and real manager (RM)) with entrepreneurial leadership ability/capacity who can provide the competitive advantages that their competitors will find hard to follow and imitate, can enhance the success rate for start-up firms in biotechnology venture growth. This new model of entrepreneurship proposes that entrepreneurial type with entrepreneurial leadership ability/capacity as the mediator including the components of R&D,

creativity and innovation, and knowledge management, will pursue the modes of exploitation in the entrepreneurial process of biotechnology venture growth.

The Entrepreneurial Process for Venture Growth

Baron and Shane (2005) refer to entrepreneurship as a process that takes place in distinct but closely interrelated phases over time, for venture growth. The entrepreneurial process is considered to be the inclusion of all the functions, activities and actions in perceiving opportunities and creating organisations in the pursuit of profit (Bygrave & Zacharakis 2008). The process approach breaks down entrepreneurial events into specific steps or stages, which is easier to analyse systematically and become more manageable for anyone to pursue or apply in the venture stages of all organisations.

The entrepreneurial process for venture growth involves these three stages: opportunity discovery, evaluation and exploitation (Shane & Venkataraman 2000). In the proposed model, the five entrepreneurial steps are: presence of opportunity; opportunity recognition; decision for opportunity exploitation; resource acquisition and process management.

In general, entrepreneurial leaders who have the entrepreneurial leadership ability/capacity and previous experience or capability in working through the entrepreneurial process, are capable of exploring their environments, identifying opportunities with exploitation and motivating participants actively in the process of value creation for entrepreneurship. Based on this, the possession of entrepreneurial leadership ability/capacity from individual entrepreneur types (PA, EI, SS and RM) can enhance the modes of exploitation in the entrepreneurial process for venture growth in major industries like the biotechnology industry.

Tables 5.18 and 5.19 show the surveyed Australian biotechnology firms by entrepreneurial type, presence of opportunity, opportunity recognition, decision for opportunity exploitation, resource acquisition and process management.

Opportunities are present in the markets, in economies, in competitive advantages, and in a network or management expertise or risk control (Table 5.18). All entrepreneurial types (PA, EI, SS and RM) rated the presence of market opportunity as the most important of the four options ranging from 4.4 to 4.7. Overall, the ascending order for the averaged ratings for presence of opportunity was: in market (mean=4.5), in competitive advantages (mean=4.3), in network or management expertise or risk control (mean=3.7), and in economies (mean=3.6).

After the stage of opportunity discovery, the next stage is opportunity evaluation. This stage comprises the critical process step of opportunity recognition. The most important abilities of a successful entrepreneur are identifying and deciding on the right opportunities for exploitation with value creation for stakeholders in prospective business ventures (Stevenson, Roberts & Grousbeck 1985).

Opportunities are recognised as changing demographics, emergence of new market segments, new process needs, new technologies, incongruities or lack of harmony, regulatory change and social change (Table 5.18). EI, SS and RM entrepreneurs rated the new technologies and emergence of new market segments as the top two most important ones for opportunity recognition, while the order of ratings by PA entrepreneurs is the opposite of EI, SS and RM entrepreneurs, by reversing as the emergence of new market segments. Overall, the ascending order for the averaged ratings for opportunity recognition was the order as EI, SS and RM entrepreneurs: new technologies (mean=3.9) and emergence of new market segments (mean=3.6).

The entrepreneurial process steps are: decision for opportunity exploitation, assembling the required resources (e.g. information, financial and people) and the process management of entrepreneurial process. Various modes of exploitation depend on the nature of the organisation in that industry, the opportunity and the individual entrepreneur difference (Shane & Venkataraman 2000; Shane 2003).

This new model of entrepreneurship proposes that entrepreneurs with the availability of both information and of entrepreneurial leadership ability/capacity will have a higher chance to exploit the entrepreneurial opportunities for biotechnology venture growth with the understanding of the organisation nature in that industry, the opportunity and the individual entrepreneur difference. The entrepreneurial leadership ability acts as the mediator between the entrepreneurial types (PA, SS, EI and RM) and the modes of opportunity exploitation in the entrepreneurial process for biotechnology venture growth.

After the opportunities are recognised, a decision for opportunity exploitation has to be made; whether to go ahead with that recognised opportunity or not. This step is critical as it leads to the pursuit of modes of opportunity exploitation in the entrepreneurial process for biotechnology venture growth. The decision for opportunity exploitation will depend on: new products, new services, new processes, new markets, new organisational structure or forms, new technologies, and new sales or distribution channels (Table 5.19). All four entrepreneurial types (PA, EI, SS and RM) rated the new products, new markets and new technologies individually as the same three most important decisions for opportunity exploitation. Overall, the ascending order for the ratings for decision for opportunity exploitation was: new products (mean=4.2), new technologies (mean=4.1) and new markets (mean=3.8).

Once the decision has been made to exploit the opportunity, all the resources should be acquired to pursue the modes of exploitation. Both financial and non-financial resources are required to pursue successful entrepreneurship. All four entrepreneurial types (PA, EI, SS and RM) individually rated the same five most important resources to be acquired as follows: skilled employees, general management expertise, technical expertise, financing and licences, patents and legal protection. Overall, the ascending order for the averaged ratings for resource acquisition was: licences, patents and legal protection (mean=4.5), financing (mean=4.4), general management expertise (mean=4.2), technical expertise (mean=4.1) and skilled employees (mean=4) (Table 5.19).

After the resource acquisition step, process management is the next step to monitor the entrepreneurial process. With process management in place the business activities are planned, designed and performed, employees will work towards the alignment of its activity goal with the overall customer-oriented organisational goals. Process management can ensure a process with explicit goals that guide the employees to perform consistently and managers to improve performance in a disciplined way. Process management engages the organising activities for the exploitation of entrepreneurial opportunities in the process. In order to exploit the recognised opportunity for which the resources have been assembled, the entrepreneurial types (PA, EI, SS or RM) have to implement process management to ensure the smoothness or the effectiveness of the entrepreneurial process.

Table 5.18 Presence of opportunity and opportunity recognition for the surveyed Australian biotechnology firms (Question 23)

Total no. of firms		Presence of opportunity					Opportunity recognition							
		In market (eg needs, customers and potential market size)	In Economy (eg profits after tax and time to break even etc)	In competitive advantage (eg barrier to entry, and degree of control over costs and prices etc)	In network/management expertise/risk control	**Average**	Changing demographics	Emergence of new market segments	New process needs	New technologies	Incongruities/ Lack of harmony	Regulatory change	Social change	**Average**
39	**Av. number**	**4.5**	**3.6**	**4.3**	**3.7**	**4**	**2.9**	**3.6**	**3.1**	**3.9**	**2.7**	**3.2**	**2.8**	**3.2**
	Av. number per process step	**4**					**3.2**							

Note: PA = Personal achiever
SS = Super sale people
RM = Real manager
EI = Expert idea generator
Importance rating: 1=Not important; 2=Less important; 3=Important; 4=Very important and 5=Extremely important

Table 5.19 Decision for opportunity exploitation, resource acquisition and process management for the surveyed Australian biotechnology firms (Question 23)

Total no. of firms		Decision for opportunity exploitation								Resource acquisition										Process management				
		New products	New services	New processes	New markets	New organisational structure/forms	New technologies	New sales or distribution channels	**Average**	Skilled employees	General management expertise	Marketing and sales expertise	Technical expertise	Financing	Distribution	Source of supply	Production facilities	Licences, patents and legal protection	**Average**	Absorption of new concept into mainstream operations	Licensing of rights with other company	Calculating the uncertainty of opportunities/risk	Company organisation design	**Average**
39	**Av. number**	**4.2**	**2.6**	**3.1**	**3.8**	**2.2**	**4.1**	**2.6**	**3.2**	**4.0**	**4.2**	**3.5**	**4.1**	**4.4**	**3.0**	**3.2**	**2.8**	**4.5**	**3.8**	**3.7**	**3.7**	**4.0**	**3.0**	**3.6**
	Av. number per process step	**3.2**								**3.8**										**3.6**				

Note: PA = Personal achiever
SS = Super sale people
RM = Real manager
EI = Expert idea generator
Importance rating: 1=Not important; 2=Less important; 3=Important; 4=Very important and 5=Extremely important

Overall, the ascending order for the averaged ratings for process management was: calculating the uncertainty of opportunities or risks (mean=4.0), absorption of new concept into mainstream operations (mean=3.7), licensing of rights with another company (mean=3.7) and company organisation design (mean=3) (Table 5.19).

Enhanced Organisational Achievement

Business models

The integrative definition of a business model adopted is "a model is a concise representation of how an interrelated set of decision variables in the areas of venture strategy, architecture, and economics are addressed to create sustainable competitive advantage in defined markets" (Morris et al. 2005).

In this new model, the following business models are often implemented by the biotechnology industry: strategic alliance with partners, refocussed current product development, launching of new products, raised public capital, raised private capital, and mergers and acquisition (Morris et al. 2005). The entrepreneurial types (PA, EI, SS and RM) with the moderating role of entrepreneurial leadership ability (EL) will influence the modes of opportunity exploitation with appropriate business models of different organisational origin in biotechnology venture growth.

Table 5.20 summarises experience of the surveyed Australian biotechnology firms by entrepreneurial type (PA, EI, SS and RM) through business model. All four entrepreneurial types rated the strategic alliance with partners as the most important business model ranging from 4.1 to 4.6, while PA entrepreneurs also rated the launched new products and SS entrepreneurs are for the raised public capital as the most important business model. It is quite interesting to observe that SS entrepreneurs recognised publicly-raised capital as one of the most important business models (mean=4.6) and RM entrepreneurs for the second important (mean=4.0) business model while PA entrepreneurs rated it as the fourth important (mean=3.2) and EI entrepreneurs as the third important business model (mean=3.9). Because of the limited private funds available, a lot of biotechnology firms rely on IPO for publicly-raised money for the next phase of company expansion or product commercialisation (Gao, Darroch & Mather 2008).

Overall, the ascending order for the averaged ratings for business models was: the strategic alliance with partners (mean=4.4), raised public capital (mean=4.0), and the launched new products (mean=3.8) (Table 5.20).

Enterprise performance

Every organisation needs to manage, measure and improve its business performance in order to maintain its survival and competitive edge. Business performance is used to measure the effectiveness of entrepreneurs in running the company (Covin & Slevin 1991).

In this new model of entrepreneurship, enterprise performance is being measured in the six groups of corporate management; technology access; resources access; market access; collaboration; geographical location (Hall & Bagchi-Sen 2002).

Table 5.21 summarises these results and business model for the surveyed Australian biotechnology firms. All entrepreneurs rated these five areas as the most important in enterprise performance: managerial skills, quality of product, ability to recognise commercial application of technology, technology transfer from suppliers/inventors and access to seed/venture capital ranging from 4.3 to 4.8. Ability to recognise commercial application of technology was the most popular and the most concentrated for individual entrepreneur rating. Overall, the ascending order for the top ratings for enterprise performance was: ability to recognise commercial application of technology (mean=4.65), managerial skills (mean=4.49), quality of product (mean=4.2) and learning from end users (mean=4.03) (Table 5.21).

Table 5.20 Business model for the surveyed Australian biotechnology firms (Question 36)

Total no. of firms		[1]Business model						
		Strategic alliance with partners	Refocussed current product development	Launched new products	Raised public capital	Raised private capital	Acquisition	Merger
39	Mean	4.4	3.1	3.8	4.0	3.5	3.2	2.9

Note: PA = Personal achiever;
SS = Super sale people;
RM = Real manager;
EI = Expert idea generator
[1]Importance rating: 1=Not important; 2=Less important; 3=Important; 4=Very important and 5=Extremely important

Table 5.21 Enterprise performance for the surveyed Australian biotechnology firms (Question 37)

Total no. of firms		[1] Enterprise Performance																
		Managerial skills	Efficiency/speed of product development	Skilled labour	Quality of product	Marketing capability	Research capability	Learning from end users	Ability to 296ecognize commercial application of technology	Technology transfer from suppliers/ inventors	Access to seed/venture capital	Government support	Access to international markets	Access to domestic markets	Collaboration with universities/research centres	Collaboration with industrial companies	Collaboration with other biotechnologynology companies	Physical proximity to collaborators
39	Mean	4.49	3.74	3.95	4.20	3.58	3.61	4.03	4.65	3.69	3.87	3.18	3.97	2.44	2.69	3.43	2.86	2.45

Note: PA = Personal achiever; SS = Super sale people
RM = Real manager; EI = Expert idea generator
[1]Importance rating: 1=Not important; 2=Less important; 3=Important; 4=Very important and 5=Extremely important

5.3 Data Analysis with Partial Least Squares Path Modeling

Detailed discussion of the Partial Least Squares Path Modeling (PLS-PM) for Structural Equation Modeling (SEM) can be referred to Section 4.6 (Appendix V). In the following sections, data analysis with PLS-PM can also be referred to the sub-section of 4.6.2.1 about the "Model Specification and Evaluation" that has very detailed description about the sequential stages of PLS-PM for assessment of measurement model and assessment of structural models.

With such sequential stages, they are made to ensure that reliable and valid constructs are obtained before attempting to draw conclusions from the relationships among constructs in the model. The following sections will discuss these two stages of the PLS assessment procedure. The evaluation criteria for these two stages can be found in Table 4.7 in Chapter 4 which is also shown below.

Table 4.7 A simple version for PLS Data Analysis Procedures and Evaluation Criteria

Step 1: Assessing measurement models
I. Item Reliability: item loadings ≧ 0.7 II. Internal Consistency: (i) composite reliability ≧ 0.7 (ii) AVE ≧ 0.5 III. Discriminant validity: (i) Square root of AVE of a given construct > correlation between this construct and other constructs; (ii) Item loadings of a construct > all other cross-item loadings of this construct
Step 2: Assessing the structural model
I. Collect the standardized path loadings II. Test significance of the path loadings III. Produce R-square values and their interpretation as in regression analysis IV. Define the direct and indirect effects and their interpretation as in path analysis V. Revise the model where it is feasible

Source: Adapted from Barclay, Higgins & Thompson (1995); Hulland (1999); Quaddus (2004); Santosa, Wei & Chan (2005)

The data analysis discussed below, particularly in the measurement model, is for reflective measures (i.e. latent constructs) only. For constructs with formative indicators (i.e. emergent constructs), it is necessary to look at the indicators' weights (see Table 5.22) that are estimated since they reveal the relative importance of the formative indicators to the creation/formation of the corresponding construct latent variables.

5.3.1 Assessment of Measurement Model

The measurement model depicts how the latent constructs are measured in terms of the observed variables and their measurement properties. It is recommended to meet the measurement model properties before proceeding to the structural model (Barclay, Higgins & Thompson 1995; Fornell & Larcker 1981). The measurement model was assessed in the following sections by examining: (1) item reliability; (2) internal consistency; and (3) discriminant validity (Barclay, Higgins & Thompson 1995; Hulland 1999). In the literature, it is very clear that the first essential tests of a model are test of reliability and validity. Reliability is defined as the consistency of measurement and in examining how reliable the measurement is and validity is defined as the accuracy of a measurement and assessing how accurate the measurement is (Holmes-Smith 2001).

In Table 4.7, testing the measurement model includes the estimation of the reliability coefficients of the measures, and also an examination of the convergent validity (or internal consistency) and discriminant validity of the research instruments. The construct reliability measures the reliability of the latent construct which means examining the internal consistency of a set of measures rather than a single variable. It provides the information on how well a set of observed variables reflects the common latent construct (Holmes-Smith 2001).

The higher the construct liability the better it is. It is suggested that criteria for measurement need to first be satisfied before proceeding to the assessment of the structural model (Barclay, Higgins & Thompson 1995; Fornell & Larcker 1981). Table 4.7 provides a very good summary of the criteria needed for assessing measurement models and structural models.

5.3.1.1 Item Reliability

Item reliability is concerned with the level of random error in a particular construct, and the item reliability analysis provides an estimation of the amount of variance in the item's measure that is due to the construct (Barclay, Higgins & Thompson, 1995). SmartPLS version 2.0 (Ringle et al. 2005) software program was conducted to measure the degree to which each of the items loaded on their respective constructs or determine the part of an indicator's variance which can be explained by the underlying latent variable.

The individual item reliability was assessed by examining the item loadings; namely, the correlations of the measures with their respective construct. The most frequently cited rule-of-thumb is to retain only those items with loading greater than or equal to 0.7, which implies that there is more shared variance between the construct and its measure than error variance (Hulland 1999; Carmines & Zeller 1979). Appendix L presents the initial item loadings of 116 observed variables in the measurement model by SmartPLS 2.0 (Ringle et al. 2005) computer package. Hair et al. (1998, p. 11) suggest the criterion of 0.5 item loading as the cut-off point. However, this study will base on the more appropriate criterion of 0.4 item loading to determine the adequacy of the reliability coefficients obtained for each measure, following the works of Chin (1998b), Wang (2003), Petter, Straub and Rai ,2007), and Wang & Wang (2012) (See Table 5.22). This is to imply that there is more shared variance between the construct and its measure than error variance (Hulland 1999; Carmines & Zeller 1981).

Table 5.22 presents the final item loadings of 66 observed items in the measurement mode with the cut-off criterion of 0.4 applied to determine the adequacy of the reliability. Fifty items with loadings below the benchmark 0.4 were discarded. Decisions for removing the items were based on the fact that removing these items would not change or weaken the underlying constructs (Nunnaly & Berstein 1994). Discarding these items was deemed necessary to prevent the lessening of the estimates of the relationships among the constructs. Therefore, the EELC model was modified and later having 66 observed items for further model evaluation. Three independent variables, organisational strategy (OO), financial and resource components of recognition of innovation barriers (IB) were removed due to the low loadings of items (≤0.4). In this study, the results provide satisfactory support for the reliability of the reflective measures. According to Gotz, Liehr-Gobbers and Krafft (2010), the item liabilities for reflective measurement models are established.

The revised model with the remaining 66 observed variables was run again by SmartPLS 2.0 (Ringle et al. 2005) computer package and the results showed that all the constructs (with the exception of one item - IBAG) now have loadings rounded to at least 0.4, as shown in Table 5.22.

Table 5.22 Summary of final loadings and weights for constructs and indicators (after the removal of low loading items)

Constructs and indicators	Type	Item/Code	Weight	Loading
Entrepreneurial types (ET) (Q24)	F			
- Personal achiever		ETPA	0.24	0.89
- Expert idea generator		ETEI	0.39	0.57
- Real manager		ETRM	0.77	0.89
Market orientation (MO) (Q38)	F			
- High market growth rate (e.g. 30-50%)		MOMR	0.43	0.64
- Reasonable market share (eg. 20%)		MOMS	0.80	0.91
Business climate (BC) (Q39)	F			
- Short time to break even and positive cash flow (e.g. under 2 years)		BCBE	0.54	0.68
- Low to moderate capital requirements		BCCR	0.75	0.85
Competitive advantages (CA) (Q40)	F			
- Moderate to strong degree of control for prices/costs/channels of supply etc		CACP	0.44	0.68
- Barriers to entry for proprietary protection/lead time/legal advantage		CABE	0.19	0.47
- Product differentiation		CAPD	0.69	0.89
Environmental uncertainty (EU) (Q41)	F			
- Legal infrastructure		EULI	0.45	0.73
- Regulatory infrastructure		EURI	0.73	0.86
- Socio-cultural infrastructure		EUSI	0.11	0.43
Entrepreneurial leadership capacity (ELC):	R			
Types of Innovation (TI) (Q28)				
- New to the firm product or service in line that at least one competitor is offering		TIFP	0.06	0.44
- New application of existing product or service, including application to a new market segment		TIEP	0.05	0.56
- Addition to a company's existing product or service line		TIAP	0.06	0.46
- Repositioning of an existing product or service		TIRP	0.09	0.66
- Process improvement for new administrative system or procedure		TINA	0.12	0.78
- Process improvement for new production method		TINP	0.06	0.44
- Process improvement for new marketing or sales approach		TINM	0.13	0.85
- Process improvement for new customer support program		TINC	0.09	0.72
- Process improvement for new logistical approach		TINL	0.07	0.69
- Process improvement for new pricing approach		TIPR	0.06	0.70
- Process improvement for new distribution channel or method		TIND	0.10	0.81
- Process improvement for new financing method		TIFM	0.10	0.75
- Process improvement for new purchasing technique		TIPT	0.06	0.57
- Process improvement for new organisational form or structure		TIOF	0.12	0.83
Recognition of innovation barriers (IB) (Q31)				
Financial				
- Lack of public funds in early stage of venture		IBPFE	0.08	0.44
- Lack of government research funds in early		IBGRE	0.07	0.41

stage of venture				
Regulatory				
- Australian government regulations (e.g. state or federal)		IBAG	0.05	0.31
- Foreign government regulations (e.g. CE/EMEA approval etc.)		IBFG	0.04	0.36
- Australian patent process		IBAP	0.09	0.54
- Foreign patent process		IBFP	0.08	0.53
Presence of opportunity (PO) (Q23)	R			
- In market (e.g. needs, customers and potential market size)		POIM	0.20	0.45
- In Economy (e.g. profits after tax and time to break even etc.)		POIE	0.73	0.91
- In competitive advantage (e.g. barrier to entry, and degree of control over costs and prices etc.)		POCA	0.01	0.36
- In network/management expertise/risk control		PONR	0.36	0.67
Opportunity recognition (OR) (Q23)	R			
- Changing demographics		ORCD	0.15	0.61
- Emergence of new market segments		ORNMS	0.23	0.71
- New process needs		ORNPN	0.27	0.71
- Incongruities/Lack of harmony		ORILH	0.27	0.77
- Regulatory change		ORRC	0.20	0.70
- Social change		ORSC	0.27	0.76
Decision for opportunity exploitation (DOE) (Q23)	R			
- New products		DOENP	0.32	0.61
- New services		DOENS	0.17	0.52
- New processes		DOENPC	0.26	0.57
- New organisational structure/forms		DOENOS	0.31	0.67
-New technologies		DOENT	0.20	0.35
- New sales or distribution channels		DOENSC	0.38	0.77
Resource acquisition (RA) (Q23)	R			
- General management expertise		RAGME	0.34	0.58
- Marketing and sales expertise		RAMSE	0.23	0.75
- Financing		RAF	0.37	0.80
- Distribution		RAD	0.34	0.82
- Source of supply		RASS	0.10	0.52
Process management (PM) (Q23)	R			
- Absorption of new concept into mainstream operations		PMNC	0.50	0.75
- Licensing of rights with other company		PMLR	0.26	0.71
- Calculating the uncertainty of opportunities/risk		PMUO	0.20	0.51
- Company organisation design		PMOR	0.46	0.72
Enhanced organisational achievement (EOA):	R			
Business model (BM) (Q36)				
- Launch new products		BMLNP	0.10	0.44
- Raised private capital		BMPUC	0.19	0.51
Enterprise performance (EP) (Q37)				
- Managerial skills		EPMS	0.38	0.71
- Efficiency/speed of product development		EPEPD	0.21	0.64
-Quality of product		EPQP	0.27	0.53
- Marketing capability		EPMC	0.28	0.64
- Learning from end users		EPLEU	0.15	0.46
- Technology transfer from suppliers/ inventors		EPTTI	0.14	0.47

Note: Type-R= reflective; F= formative

5.3.1.2 Internal Consistency

After the reliability assessment was completely done to satisfaction, the model was undergoing another assessment to measure the internal consistency of the constructs. Internal consistency is concerned with the measure of reliability of a construct. The measure of internal consistency from Fornell and Larcker (1981) was employed in this study.

In this study, the internal consistency of the constructs in the EELC model was computed by evaluating the value of composite reliability and the Average Variance Extracted (AVE). These two values which were produced by SmartPLS version 2 (Ringle et al. 2005) software was later carefully examined for the acceptability level. The suggested acceptable value of composite reliability is 0.7 or higher (Barclay, Higgins & Thompson 1995; Fornell & Larcker 1981) and AVE of 0.5 or higher (See Table 4.7). AVE is the averaged variance shared between a construct and its measures and the value provided by SmartPLS output is recommended to be equal or greater than 0.5. Utilising the formula to calculate the value of composite reliability in Section 2.6.2.2 of Chapter 2, the model was evaluated for internal consistency (Fornell & Larcker 1981). Although this measurement is similar to the Cronbach Alpha measure of internal consistency, Fornell and Larcker (1981) argued that their measure is an improved method as they claimed that the number of items in the model does not affect their measures.

Table 5.23 Summary of composite reliability and average variance extracted for constructs and indicators (after the removal of low loading items)

Constructs and indicators	Type	Item/Code	Composite reliability	AVE
Entrepreneurial types (ET) (Q24)	F		0.6712	0.4283
- Personal achiever		ETPA		
- Expert idea generator		ETEI		
- Real manager		ETRM		
Market orientation (MO) (Q38)	F		0.7604	0.6204
- High market growth rate (e.g. 30-50%)		MOMR		
- Reasonable market share (e.g. 20%)		MOMS		
Business climate (BC) (Q39)	F		0.7384	0.5884
- Short time to break even and positive cash flow (eg under 2 years)		BCBE		
- Low to moderate capital requirements		BCCR		
Competitive advantages (CA) (Q40)	F		0.7297	0.4887
- Moderate to strong degree of control for prices/costs/channels of supply etc.		CACP		
- Barriers to entry for proprietary protection/lead time/legal advantage		CABE		
- Product differentiation		CAPD		
Environmental uncertainty (EU) (Q41)	F		0.7224	0.4817
- Legal infrastructure		EULI		
- Regulatory infrastructure		EURI		
- Socio-cultural infrastructure		EUSI		
Entrepreneurial leadership capacity (ELC):	R		0.9187	0.3782
Types of Innovation (TI) (Q28)				
- New to the firm product or service in line that at least one competitor is offering		TIFP		
- New application of existing product or service, including application to a new market segment		TIEP		
- Addition to a company's existing product or service line		TIAP		
- Repositioning of an existing product or service		TIRP		
- Process improvement for new administrative system or procedure		TINA		
- Process improvement for new production method		TINP		
- Process improvement for new marketing or sales approach		TINM		
- Process improvement for new customer support program		TINC		
- Process improvement for new logistical approach		TINL		
- Process improvement for new pricing approach		TIPR		
- Process improvement for new distribution channel or method		TIND		
- Process improvement for new financing method		TIFM		
- Process improvement for new purchasing technique		TIPT		
- Process improvement for new organisational form or structure		TIOF		
Recognition of innovation barriers (IB) (Q31)				
Financial				
- Lack of public funds in early stage of venture		IBPFE		
- Lack of government research funds in early		IBGRE		

stage of venture				
Regulatory				
- Australian government regulations (e.g. state or federal)		IBAG		
- Foreign government regulations (e.g. CE/EMEA approval etc.)		IBFG		
- Australian patent process		IBAP		
- Foreign patent process		IBFP		
Presence of opportunity (PO) (Q23)	R		0.7073	0.4042
- In market (e.g. needs, customers and potential market size)		POIM		
- In Economy (e.g. profits after tax and time to break even etc.)		POIE		
- In competitive advantage (e.g. barrier to entry, and degree of control over costs and prices etc.)		POCA		
- In network/management expertise/risk control		PONR		
Opportunity recognition (OR) (Q23)	R		0.8595	0.5063
- Changing demographics		ORCD		
- Emergence of new market segments		ORNMS		
- New process needs		ORNPN		
- Incongruities/Lack of harmony		ORILH		
- Regulatory change		ORRC		
- Social change		ORSC		
			0.3536	0.3536
Decision for opportunity exploitation (DOE) (Q23)	R			
- New products		DOENP		
- New services		DOENS		
- New processes		DOENPC		
- New organisational structure/forms		DOENOS		
-New technologies		DOENT		
- New sales or distribution channels		DOENSC		
			0.8282	0.5063
Resource acquisition (RA) (Q23)	R			
- General management expertise		RAGME		
- Marketing and sales expertise		RAMSE		
- Financing		RAF		
- Distribution		RAD		
- Source of supply		RASS		
			0.7718	0.4632
Process management (PM) (Q23)	R			
- Absorption of new concept into mainstream operations		PMNC		
- Licensing of rights with other company		PMLR		
- Calculating the uncertainty of opportunities/risk		PMUO		
- Company organisation design		PMOR		
Enhanced organisational achievement (EOA):	R		0.7795	0.3124
Business model (BM) (Q36)				
- Launch new products		BMLNP		
- Raised private capital		BMPUC		
Enterprise performance (EP) (Q37)				
- Managerial skills		EPMS		
- Efficiency/speed of product development		EPEPD		
-Quality of product		EPQP		
- Marketing capability		EPMC		
- Learning from end users		EPLEU		
- Technology transfer from suppliers/ inventors		EPTTI		

Note: Type-R= reflective; F= formative; n.a.= not applicable; AVE=Average variance extracted

Table 5.23 lists out the composite reliability and AVE for all constructs used in the EELC model. Most of the constructs exceeded the suggested minimum requirement of 0.7 for composite reliability, which were the constructs of “environmental uncertainty (0.72)”, “business climate (0.74)”, “market orientation (0.76)” “competitive advantages (0.73)”, “entrepreneurial leadership capacity (0.91)”, “presence of opportunity (0.70)”, “opportunity recognition (0.86)”, “resource acquisition (0.83)”, “process management (0.77)” and “enhanced organisational achievement (0.78)”. Thus, an adequate construct reliability for reflective measurement models was established. In Table 5.23, some of the constructs were very close to the recommended threshold of 0.5 for AVE, which were the constructs of “environmental uncertainty (0.48)”, “presence of opportunity (0.40)”, “decision for opportunity exploitation (0.35)” and “process management (0.46)” etc. Therefore, the convergent validity of the measures for the reflective latent variables have been fairly established (Fornell & Larcker 1981). For other constructs, although they have low AVE value, their composite reliability were still within the acceptable range.

5.3.1.3 Discriminant Validity

After the model of EELC had undergone two rigorous tests of item reliability and internal consistency, the next test was to determine the discriminate validity which refers to the degree to which constructs differ with each other in the same model (Barclay, Higgins & Thompson 1995; Hulland 1999). Typically, PLS assesses discriminant validity by examining the correlation at both (1) construct and (2) item level.

At Construct Level

Discriminant validity assessment measures the extent to which a given construct differs from other constructs (Barclay, Higgins & Thompson 1995; Hulland, 1999). The first test is to ensure than a construct should not share more variance with its measures than it shares with other constructs in EELC model. Fornell and Larcker (1981) proposed using the AVE, where the value of AVE should be greater than the variance shared with other constructs in the model. This study used the square root of the AVE of a construct to assess the discriminant validity, as suggested by Igbaria, Guimaraes and Davis (1995b). Barclay, Higgins and Thompson (1995) also suggested that the model is assessed to have acceptable discriminant validity if the square root of the AVE of a construct is larger than its correlation with other constructs. Table 5.24 presents the correlation matrix for all 12 constructs used in EELC model. The diagonal elements shown in this matrix are the square roots of the constructs' AVE (see Table 5.24) and the off-diagonal values indicate the correlation with other constructs. For the model to demonstrate discriminant validity, the diagonal values should be greater than the off-diagonal elements in the corresponding rows and columns (Barclay, Higgins & Thompson, 1995; Hulland 1999). As seen from the matrix in Table 5.24, all items on the diagonal values of the matrix are greater than the corresponding items in rows and columns, except two off-diagonal items highlighted in red were higher than the diagonal values. That is, all constructs share more variance with their own measures than with other constructs. The discriminant validities of the measures for the reflective latent variables have been confirmed (Fornell & Larcker 1981). Thus, the reflective measures for latent constructs in the research model are adequately reliable and valid, which have met the first criterion of the discriminant validity test.

Table 5.24 Correlation and Discriminant Validity of Constructs for EELC Model

	BC	CA	DOE	EOA	ELC	ET	EU	MO	OR	PO	PM	RA
BC	0.7670	0	0	0	0	0	0	0	0	0	0	0
CA	0.0474	0.6991	0	0	0	0	0	0	0	0	0	0
DOE	0.1078	-0.0675	0.5946	0	0	0	0	0	0	0	0	0
EOA	0.2097	0.0147	0.442	0.5589	0	0	0	0	0	0	0	0
ELC	0.1762	0.2182	0.598	0.3007	0.6150	0	0	0	0	0	0	0
ET	0.0955	0.1391	0.3728	0.381	0.5643	0.6544	0	0	0	0	0	0
EU	0.1328	0.2899	0.0404	0.0552	0.2774	0.2546	0.6940	0	0	0	0	0
MO	-0.029	-0.0062	0.1501	-0.084	0.3175	0.0677	0.009	0.7877	0	0	0	0
OR	0.169	0.3308	0.1786	0.1892	0.5981	0.3126	0.2975	0.0609	0.7115	0	0	0
PO	0.2569	0.3432	0.1816	0.5515	0.2258	0.1126	-0.0253	0.0944	0.3764	0.6358	0	0
PM	0.2193	0.2415	0.3286	0.6247	0.4307	0.4875	0.2925	0.004	0.4425	0.4612	0.6806	0
RA	0.0889	0.2288	0.385	0.613	0.2759	0.0033	0.1101	0.0218	0.2238	0.4404	0.4266	0.7058

At Item Level

The second criterion for discriminant validity is at item level. In order to satisfy the second criterion an item should not load higher on another construct than it does on the construct it aims to measure (Barclay, Higgins & Thompson 1995; Hulland 1999). By using results from SmartPLS version 2 (Ringle et al. 2005) software analysis, cross-loading analysis is performed and the result can be referred to Table 5.25. It is noted that all items loaded higher on the construct that they were measuring than they did on the other constructs in EELC model. Thus, all constructs in the model met the second discriminant validity criterion.

5.3.2 Assessment of Structural Model

As discussed in the previous chapter, the structural model of entrepreneurship with entrepreneurial leadership capacity (EELC) was done in terms of the explanatory power and significance of paths among the constructs (Chin & Newsted 1999). PLS allows a technique called bootstrapping to make an assessment of the structural EELC model. The bootstrapping technique employs a test that is similar to the traditional t-test and the results are used to interpret the significance of the paths between model constructs (Barclay, Higgins & Thompsons 1995). This method also produces the squared multiple correlation or R values that are accessed as a measure of the predictive power of the model for the endogenous constructs (Barclay, Higgins & Thompsons 1995).

Table 5.25 Cross loadings of items in EELC model

	BC	CA	DOE	EOA	ELC	ET	EU	MO	OR	PO	PM	RA
BCBE	0.675	0.1435	0.0836	0.0739	0.1006	-0.0002	0.0023	0.0404	0.0528	0.1692	0.1883	-0.0104
BCCR	0.8493	-0.0395	0.0838	0.2265	0.1628	0.1273	0.1753	-0.0675	0.1873	0.2212	0.1575	0.1259
BMLNP	0.2077	-0.0456	0.3837	0.4408	0.2802	0.2344	-0.0483	0.0066	-0.0645	0.157	0.1335	0.3115
BMPUC	0.0609	-0.2391	0.2151	0.5139	0.0387	0.3183	0.1901	0.1432	-0.1031	0.0712	0.2801	0.2762
CABE	-0.1558	0.4714	-0.0125	-0.1316	0.0413	-0.0104	0.2637	0.3488	0.0308	0.1052	0.0907	0.1261
CACP	0.1039	0.678	-0.1996	-0.0494	0.1429	0.0519	0.35	-0.0464	0.2063	0.2063	0.1443	0.1827
CAPD	0.0464	0.8855	0.0317	0.089	0.2135	0.171	0.1247	-0.0768	0.339	0.3363	0.2325	0.1802
DOENOS	-0.0379	0.0333	0.6665	0.1884	0.4268	0.2504	0.061	0.1406	0.1865	0.1183	0.3984	0.2114
DOENP	-0.0844	-0.1376	0.6096	0.3004	0.2704	0.1306	-0.1205	0.1714	-0.2479	0.2252	0.2007	0.2591
DOENPC	0.2122	-0.107	0.5678	0.436	0.3456	0.5016	0.2317	0.0107	0.1295	0.0207	0.1653	0.1767
DOENS	-0.0316	-0.1327	0.5217	0.2655	0.1226	-0.0559	-0.1629	0.0507	-0.047	-0.0472	0.039	0.2387
DOENSC	0.1433	0.0101	0.7658	0.2061	0.5633	0.2332	-0.1033	0.0224	0.3982	0.0725	0.2059	0.3119
DOENT	0.2149	0.0655	0.3532	0.2528	0.2745	0.2273	0.3393	0.1543	0.1249	0.234	0.0681	0.1543
EPEPD	0.1399	0.0904	0.2552	0.6381	0.0829	0.0324	-0.0876	-0.0684	0.1083	0.6123	0.3145	0.5034
EPLEU	0.1996	0.1353	0.1225	0.4646	0.0847	-0.0497	0.0659	-0.2054	0.2263	0.4623	0.2283	0.4389
EPMC	0.2786	0.1044	0.4853	0.6375	0.4952	0.1409	-0.2089	0.0157	0.2853	0.4426	0.3942	0.6056
EPMS	0.0213	0.129	0.2761	0.7108	0.1331	0.3775	0.2477	-0.1321	0.2734	0.3332	0.5637	0.3524
EPQP	0.1164	-0.1443	0.1026	0.5347	0.2155	0.3872	0.0153	-0.0579	-0.0193	0.1584	0.3927	0.1894
EPTTI	0.0018	-0.1108	0.1707	0.4693	-0.0832	0.1008	-0.0419	-0.0318	-0.1486	0.2203	0.2162	0.0273
ETEI	0.0454	0.1827	0.2701	0.3164	0.2281	0.5746	-0.0408	0.141	0.2568	0.2836	0.2094	0.0188
ETPA	0.0349	-0.0121	0.1583	0.1471	0.1911	0.4092	0.232	0.0149	-0.0184	-0.0692	0.1506	-0.0804
ETRM	0.0907	0.0934	0.3009	0.2919	0.5615	0.8874	0.2799	0.0128	0.2845	0.026	0.4834	0.02

Table 5.25 Cross loadings of items in EELC model (continued)

	BC	CA	DOE	EOA	ELC	ET	EU	MO	OR	PO	PM	RA
EULI	0.0971	0.3239	-0.0852	0.0277	0.173	0.3187	0.7268	0.0316	0.4437	0.0374	0.3314	0.0028
EURI	0.0638	0.1512	0.1561	0.0642	0.2663	0.1491	0.8565	-0.0184	0.0744	-0.0702	0.1515	0.1445
EUSI	0.3705	0.2933	-0.3	-0.0346	0.0501	0.0197	0.4283	0.07	0.3734	0.0766	0.2836	0.0339
IBAG	-0.1316	0.0028	0.082	0.4198	0.3095	0.112	0.1538	0.0928	0.2839	0.0705	0.1156	0.3361
IBAP	0.147	0.1033	0.3045	0.2962	0.5442	0.0877	0.229	0.3472	0.4035	0.23	0.2551	0.3941
IBFG	0.0036	-0.0572	-0.0088	0.3096	0.3615	0.1326	0.1722	0.0563	0.3776	-0.0392	0.0561	0.1006
IBFP	0.0411	0.2093	0.2524	0.2428	0.532	0.1334	0.3392	0.1674	0.4056	0.0611	0.2472	0.3718
IBGRE	0.1686	0.0362	0.3676	0.3128	0.4132	0.219	0.2381	0.1649	0.12	0	0.2183	0.3685
IBPFE	0.1491	0.1959	0.3002	0.0748	0.443	0.2056	0.3068	0.3961	0.3549	0.1238	0.2464	0.2826
MOMR	-0.0758	-0.0964	-0.0906	-0.1443	0.2146	-0.0331	-0.0285	0.642	0.0614	-0.1109	-0.119	0.035
MOMS	0.0045	0.0443	0.2375	-0.0277	0.2832	0.1029	0.0266	0.9103	0.0434	0.1786	0.0692	0.0086
ORCD	0.0698	0.3353	-0.138	-0.0018	0.2561	0.1221	0.2154	-0.1085	0.605	0.3209	0.2774	0.1471
ORILH	0.0342	0.1484	0.1713	0.1242	0.4629	0.1498	0.0957	0.2818	0.7692	0.3494	0.363	0.2419
ORNMS	0.0493	0.2075	0.1205	0.1447	0.4677	0.2814	0.0854	-0.2015	0.7138	0.1423	0.1931	0.0845
ORNPN	0.0111	0.3162	0.2017	0.1927	0.4617	0.2716	0.3524	0.1106	0.706	0.2848	0.2914	0.2283
ORRC	0.1623	0.2061	0.0759	0.0724	0.4424	0.2896	0.3478	0.0599	0.6994	0.0888	0.3832	0.0298
ORSC	0.3778	0.2498	0.2026	0.2075	0.4185	0.2132	0.2059	0.0153	0.7635	0.3977	0.3791	0.1848
PMLR	0.0861	0.1445	0.2976	0.2833	0.2374	0.3566	0.2553	-0.021	0.3143	0.0981	0.711	0.154
PMNC	0.1543	0.0904	0.1794	0.5885	0.2726	0.3886	0.0641	-0.07	0.3149	0.2728	0.7508	0.4026
PMOR	0.2309	0.3216	0.3059	0.4627	0.4316	0.3595	0.3101	0.0816	0.3163	0.561	0.7238	0.3304
PMUO	0.0614	0.0462	0.0943	0.2007	0.1587	0.161	0.2534	0.0357	0.2797	0.1944	0.5095	0.154
POCA	-0.0998	-0.0418	0.1398	0.2347	0.1091	0.0923	0.1222	0.0346	0.1416	0.3638	0.284	0.318

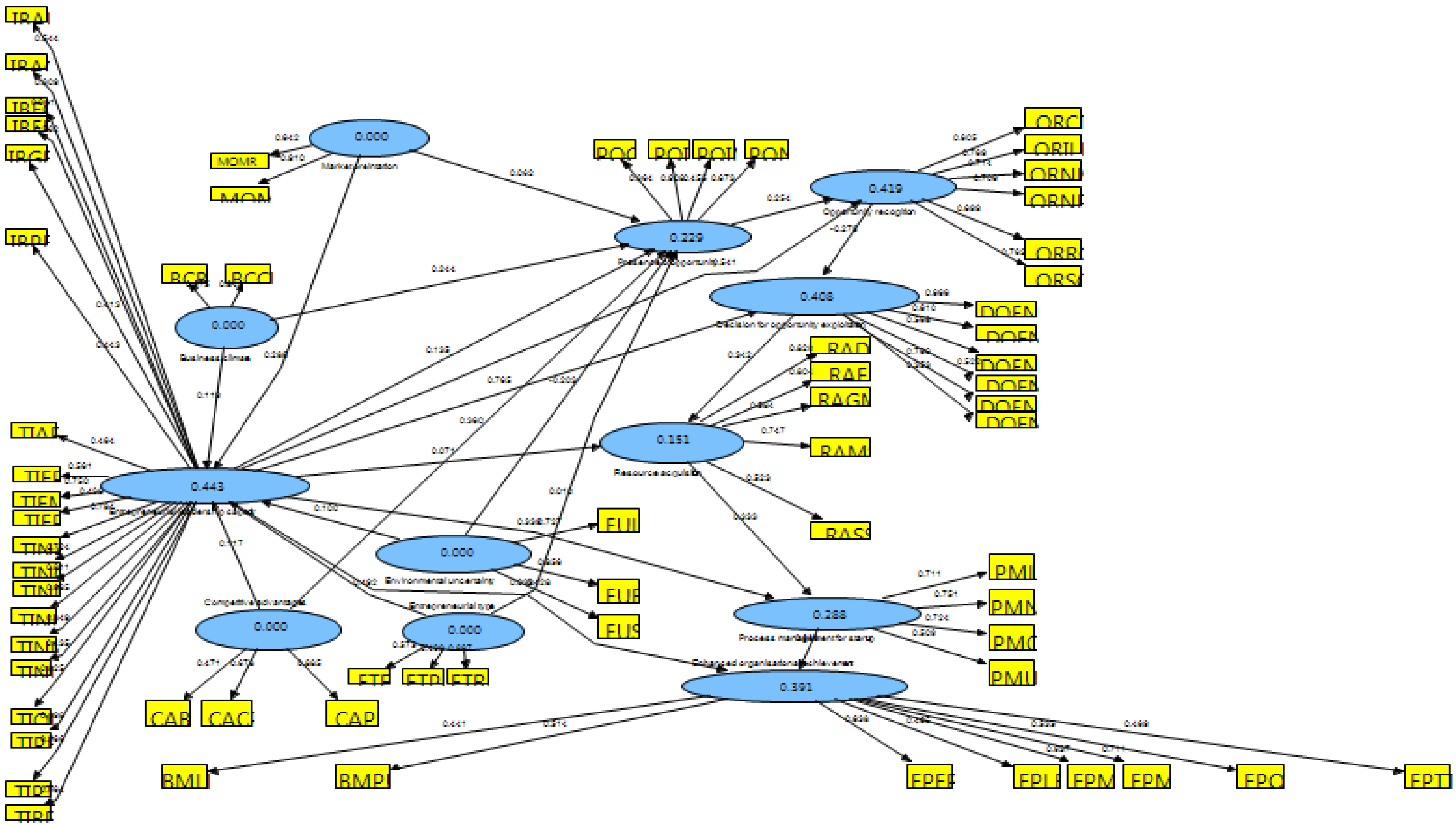
Table 5.25 Cross loadings of items in EELC model (continued)

	BC	CA	DOE	EOA	ELC	ET	EU	MO	OR	PO	PM	RA
POIE	0.2281	0.4205	0.1888	0.4516	0.2829	0.1285	-0.0222	0.1362	0.3357	0.9081	0.4157	0.3896
POIM	0.1014	-0.0175	-0.0111	0.414	-0.0649	0.1271	-0.2486	-0.0118	0.1224	0.4549	0.1719	0.0144
PONR	0.1995	0.1125	0.1236	0.3782	0.0865	-0.0233	0.1112	-0.0089	0.2934	0.673	0.3339	0.4173
RAD	0.2302	0.1624	0.3815	0.5186	0.2735	-0.177	-0.0286	-0.1399	0.2883	0.4444	0.2626	0.8196
RAF	0.1104	0.0266	0.2689	0.4958	0.0769	-0.0022	0.2216	0.0383	-0.0009	0.2472	0.4428	0.8038
RAGME	-0.0846	0.2548	0.1617	0.3962	0.2587	0.2779	0.1049	0.1704	0.2802	0.3106	0.4408	0.5843
RAMSE	-0.0264	0.2421	0.3453	0.386	0.1994	-0.1548	-0.1153	-0.0978	0.0853	0.2725	0.1137	0.7473
RASS	0.0486	0.2089	0.2074	0.2938	0.2052	0.0615	0.2872	0.1984	0.1168	0.2932	-0.0153	0.5226
TIAP	0.1602	0.263	0.2622	0.0243	0.464	0.3552	0.1026	0.0983	0.2327	0.1465	0.2088	0.0339
TIEP	0.3399	0.0722	0.3559	0.1886	0.5607	0.1017	0.0716	0.0543	0.262	0.0174	0.0998	-0.0021
TIFM	0.2177	0.2738	0.4009	0.0728	0.7503	0.551	0.3521	0.2846	0.4075	0.1943	0.3028	0.0708
TIFP	0.0047	0.105	0.3501	0.1002	0.4386	0.4149	0.2097	0.0471	0.2478	-0.077	0.2058	0.0344
TINA	0.1928	0.1278	0.5458	0.1695	0.7839	0.5458	0.1744	0.3607	0.4696	0.2734	0.3705	0.1647
TINC	-0.0631	0.0482	0.4049	0.1836	0.7237	0.5077	0.0644	0.1097	0.3976	0.0688	0.2576	0.1705
TIND	0.218	0.1374	0.5057	0.3211	0.8115	0.4244	0.067	0.1261	0.4336	0.2025	0.35	0.1735
TINL	-0.0091	0.1683	0.3011	-0.0848	0.6851	0.3001	0.1051	0.3127	0.4262	-0.0059	0.115	0.1339
TINM	0.0933	0.1992	0.5623	0.4388	0.8494	0.4947	0.0545	0.0692	0.4804	0.3785	0.5074	0.354
TINP	0.2622	-0.1182	0.3335	0.167	0.4351	0.2931	0.3365	-0.0408	0.2478	0.0717	0.2391	0.0276
TIOF	0.0941	0.2267	0.5265	0.1802	0.825	0.5213	0.2978	0.443	0.4849	0.2727	0.4397	0.1662
TIPR	0.0768	0.0615	0.2494	-0.0318	0.698	0.3513	0.0148	0.2636	0.3781	0.0526	0.2176	0.0189
TIPT	-0.0962	0.212	0.249	-0.0535	0.5659	0.386	0.2951	0.2295	0.3697	0.0142	0.0455	-0.0713
TIRP	0.1726	0.1864	0.4815	0.2655	0.6638	0.3711	-0.0383	0.0927	0.4167	0.1745	0.287	0.0951

The R values are interpreted in a similar manner to the results of multiple regression analysis (Barclay, Higgins & Thompsons 1995). The R for observed variables tell how well the observed variables measure their underlying latent constructs both individually and as a group. It is calculated as the square of observed variables' standardised SmartPLS loading. The R for the structural equation reflects the proportion of variance of dependent variables explained by the variables in the structural equation (Ringle et al. 2005). The values of R ranges from 0 to 1. Holmes-Smith (2001) recommended that R should exceed 0.5, while Santosa et al. (2005) suggested 0.1 to be an acceptable R^2 value.

The following sections will describe the detail of the assessment procedure undertaken in this study of the main model of the EELC as shown in Figure 5.2 (the figure was a snapshot from the output of SmartPLS version 2 software) after the removal of lower loadings. The procedure includes the R values and the hypothesis testing of the second order model. Appendix M shows the original path diagram for the EELC model before the removal of low loading items.

Figure 5.2 Overall path diagram for EELC model by SmartPLS (after the removal of low loading items)



5.3.2.1 R^2 value

The R^2 values or explanatory powers reflect the amount of variance explained by the model or the predictive power of the model. The value reflects the proportion of variance of dependent variables explained by the variables in the structural equations. A small R^2 values reflect weak relationships and indicates that the model is not good (Chin & Newsted 1999). The values of R^2 range from 0 to 1 and it is recommended that the R^2 should exceed 0.1 for the model to be considered good (Santosa et al. 2005).

Table 5.26 shows the R values for the main EELC model. It shows that the model explains 44% (R^2=0.44) of the variance in Entrepreneurial Leadership Capacity variable, 23% (R^2=0.23) of the variance in Presence of Opportunity variable, 42% (R^2=0.42) of the variance in Opportunity Recognition variable, 41% (R^2=0.41) of the variance in Decision for Opportunity Exploitation variable, 13% (R^2=0.13) of the variance in Resource Acquisition variable, 29% (R^2=0.29) of the variance in Process Management for Start-up variable, and 39% (R^2=0.39) of the variance in Enhanced Organisational Achievement variable.

Table 5.26 Summary of R^2 values of the constructs in EELC model

Construct	R Square
Entrepreneurial leadership capacity	0.44
Presence of opportunity	0.23
Opportunity recognition	0.42
Decision for opportunity exploitation	0.41
Resource acquisition	0.13
Process management for start-up	0.29
Enhanced organisational achievement	0.39

In this study, the PLS results show that the model exhibits explanatory power in the neighbourhood of 44% in the Entrepreneurial Leadership Capacity variable. It means that the model explained 44% of the variance in the Entrepreneurial

Leadership Capacity variable, which is reasonably good (Holmes-Smith 2001). For the Enhanced Organisational Achievement variable, the model explained 39% of the variance. It is interesting to note that the percentage of variance explained of constructs, namely, Opportunity Recognition, Decision for Opportunity Exploitation, Process Management for Start-up variables were acceptable. However, it is surprising to find that the percentage of variance in Presence of Opportunity variable was relatively low.

5.3.2.2 Hypothesis Testing

The twenty-three (23) hypotheses testing will be based on Figure 3.4 in Chapter 3 which is also reproduced below as well. To test the hypotheses, PLS employs a technique called bootstrapping. Bootstrapping employs a test similar to the traditional t-test and the result can be used to interpret the significance of the paths between model constructs Barclay, Higgins & Thompsons 1995). In this study, an EELC model for high-technology ventures is proposed which will enhance the pursuit of modes of exploitation with good business models and enterprise performance. The output from bootstrapping which shows the result of structural models of EELC via SmartPLS version 2 software (Ringle et al. 2005), is diagrammatically represented in Figure 5.3. The path coefficients and t-statistics results of the bootstrapping calculations are summarised in these two similar tables, Table 5.27 (actual hypotheses) and Table 5.28 (construct relationship). Appendix N shows the original path diagram for the EELC model with bootstrapping before the removal of low loading items.

Besides the seventeen hypotheses (H_1 - H_{17}**)** to test the proposed EELC model, the next six (6) hypotheses (H_{18} - H_{23}**)** will test the impact of the mediator role from entrepreneurial leadership capacity (ELC) between the independent variables (e.g.

entrepreneurial type, market orientation, business climate, environmental uncertainty, competitive advantages and organisational strategy) and the dependent variable (presence of opportunity) in high-technology ventures (Figure 3.4 in Chapter 3). These six hypotheses (H_{18} - H_{23}**)** will test, in the absence of the mediator "Entrepreneurial Leadership Capacity", whether each independent variable will have positive association with the construct "Presence of Opportunity" which is the beginning of entrepreneurial process for high-technology venture creation (Figure 3.4). However, H_6 and H_{23} were not tested due to the deletion of low loading of items.

Figure 3.4 Twenty three (23) hypotheses for research model of entrepreneurship

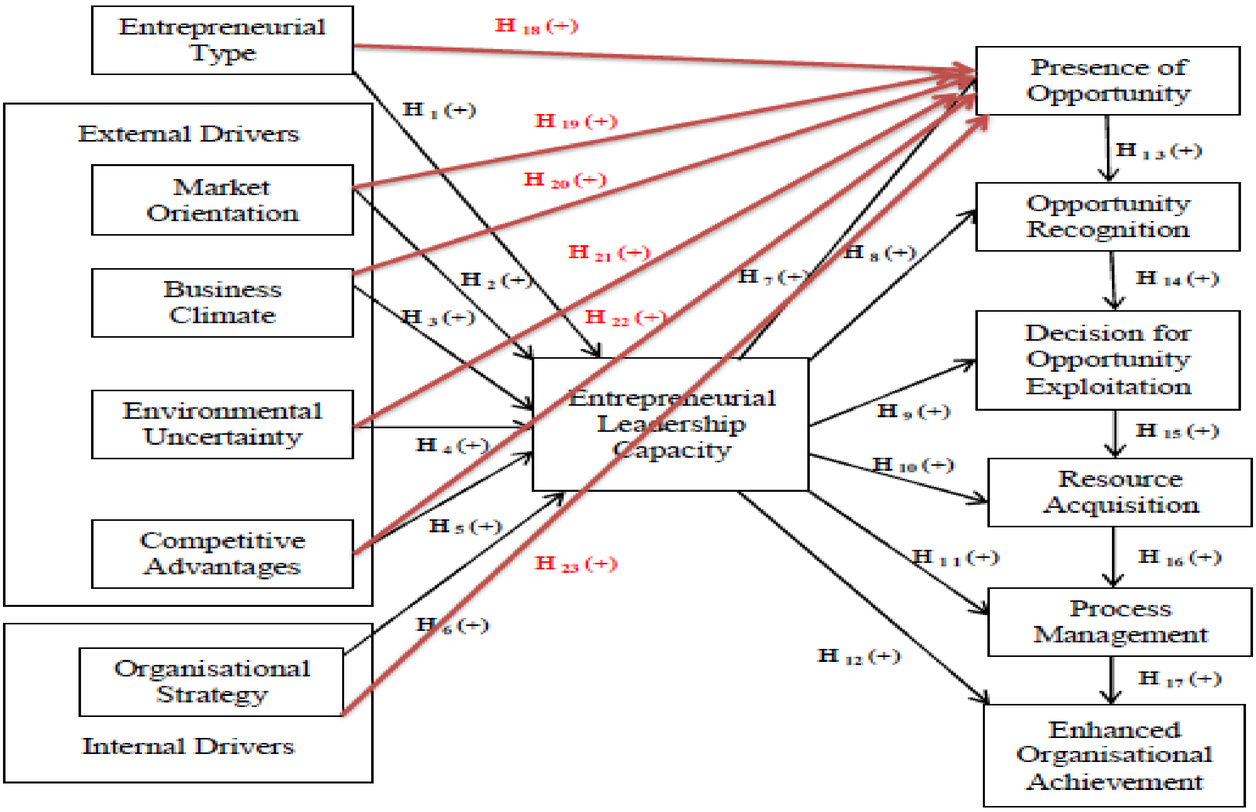


Figure 5.3 Overall path diagram for EELC model with bootstrapping by SmartPLS (after the removal of low loading items)

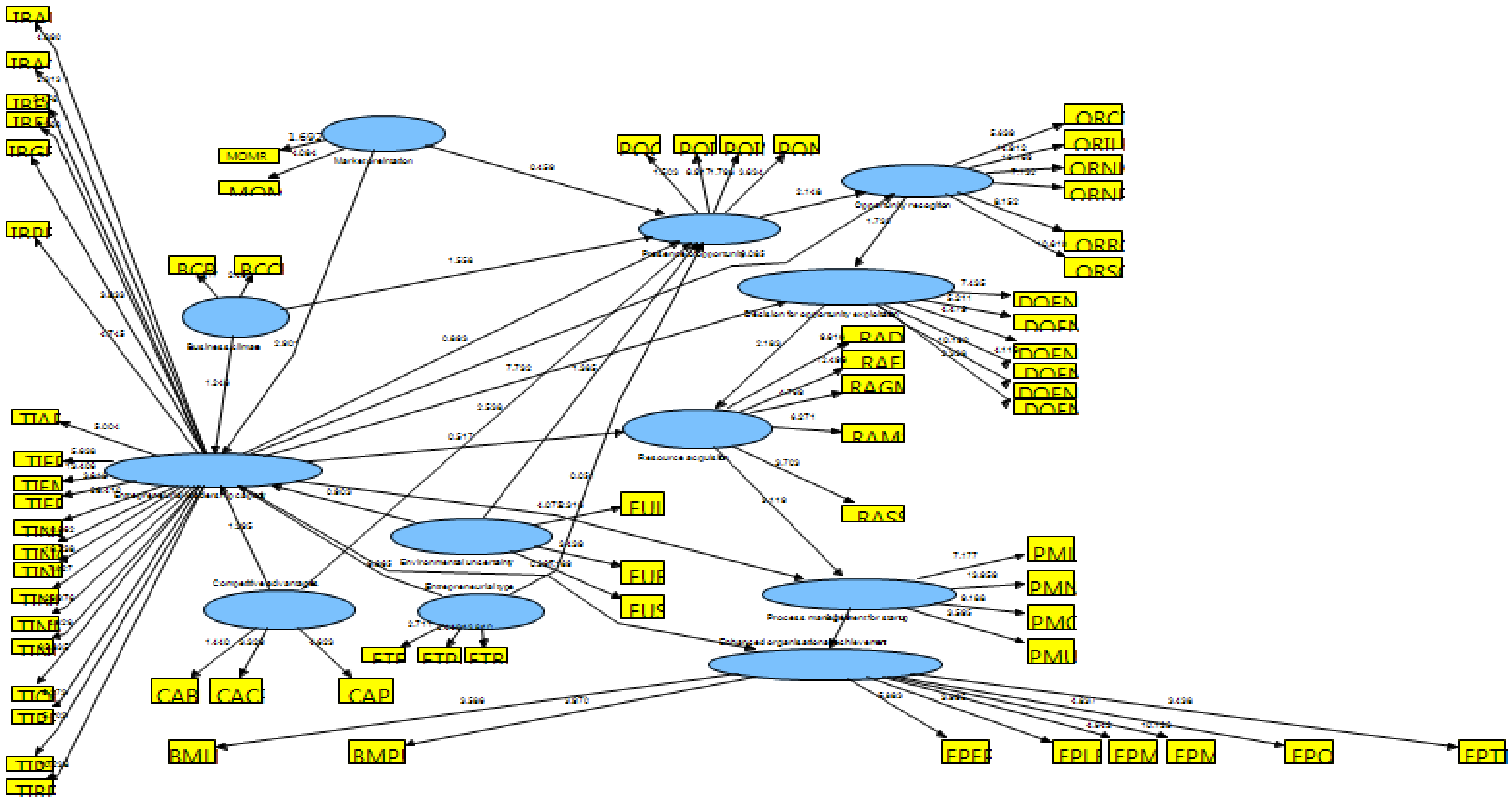


Table 5.27 Results of hypothesis testing

Hypothesis		Finding		Support of hypothesis
		Path coefficient	*t*-value	
H_1	*The most appropriate entrepreneurial type is positively associated with entrepreneurial leadership capacity (ELC) in high-technology ventures*	0.4918	6.9651	Yes *** Highly supported
H_2	*Market orientation is positively associated with entrepreneurial leadership capacity (ELC) in high-technology ventures*	0.2875	2.9012	Yes *** Highly supported
H_3	*Business climate is positively associated with entrepreneurial leadership capacity (ELC) in high-technology ventures*	0.1188	1.2458	-- Not supported
H_4	*Environmental uncertainty is positively associated with entrepreneurial leadership capacity (ELC) in high-technology ventures*	0.0999	0.9033	-- Not supported
H_5	*Competitive advantages are positively associated with entrepreneurial leadership capacity (ELC) in high-technology ventures*	0.1169	1.295	-- Not supported
H_7	*Successful deployment of entrepreneurial leadership capacity (ELC) is more likely to find the presence of opportunity in high-technology ventures*	0.135	3.316	Yes *** Highly supported
H_8	*Successful deployment of entrepreneurial leadership capacity (ELC) is more likely to recognise the opportunity in high-technology ventures*	0.5406	6.0853	Yes *** Highly supported
H_9	*Successful deployment of entrepreneurial leadership capacity (ELC) is more likely to decide for opportunity exploitation in high-technology ventures*	0.7648	7.7323	Yes *** Highly supported
H_{10}	*Successful deployment of entrepreneurial leadership capacity (ELC) is more likely to acquire the resources in high-technology ventures*	0.0711	0.5174	-- Not supported
H_{11}	*Successful deployment of entrepreneurial leadership capacity (ELC) is more likely to have start-up process management in high-technology ventures*	0.3388	4.0755	Yes *** Highly supported
H_{12}	*Successful deployment of entrepreneurial leadership capacity (ELC) is more likely to have enhanced organisational achievement (business models and enterprise performance) in high-technology ventures*	0.0388	6.455	Yes *** Highly supported
H_{13}	*Presence of opportunity will positively influence the opportunity recognition in high-technology ventures*	0.2543	2.1485	Yes* supported
H_{14}	*Opportunity recognition will positively influence the decision for opportunity exploitation in high-technology ventures*	-0.2788	1.7332	-- Not supported
H_{15}	*Decision for opportunity exploitation will positively influence the resource acquisition in high-technology ventures*	0.3425	2.1834	Yes* supported
H_{16}	*Resource acquisition will positively influence the start-up process management in high-technology ventures*	0.3331	3.1186	Yes** Well supported
H_{17}	*Start-up Process management will positively influence the enhanced organisational achievement (business models and Enterprise performance) in high-technology ventures*	0.608	8.2192	Yes *** Highly supported

Note: * = t >1.96 at p < 0.05; ** = t > 2.576 at p < 0.01, *** = t > 3.29 at p < 0.001 (based on $t_{39)}$, two-tailed test); "—" = no significant difference

Table 5.27 Results of hypothesis testing (continued)

Hypothesis		Finding		Support of hypothesis
		Path coefficient	*t*-value	
H_{18}	*The entrepreneurial type is more likely to find the presence of opportunity in high-technology ventures*	0.0105	0.0514	-- Not supported
H_{19}	*Market orientation is positively associated with the presence of opportunity in high-technology ventures*	0.062	0.4595	-- Not supported
H_{20}	*Business climate is positively associated with the presence of opportunity in high-technology ventures*	0.2437	1.5578	-- Not supported
H_{21}	*Environmental uncertainty is positively associated with the presence of opportunity in high-technology ventures*	-0.2026	1.3848	-- Not supported
H_{22}	*Competitive advantages are positively associated with the presence of opportunity in high-technology ventures*	0.1418	0.8779	-- Not supported

Note: * = t >1.96 at $p < 0.05$,
** = t > 2.576 at $p < 0.01$,
*** = t > 3.29 at $p < 0.001$ (based on $t_{39)}$, two-tailed test);
"—" = no significant difference

Detailed discussion for each hypothesis testing will be referred to the "Discussion" section later in this chapter. Table 5.27 and Table 5.28 list the result of path coefficients and *t*-values of the hypotheses. The levels of significance (5%, 1% and 0.1%) were tested in this bootstrapping procedure.

Overall, the tests of hypotheses provided mixed results on the proposed relationships. Hypotheses H_1, H_2, H_7, H_8, $H_{9,}$ H_{11}, H_{12} and H_{17} were accepted when the t-values (0.1% level) were above 3.29. Hypothesis H_{16} was accepted when t-values (1% level) were above 2.576. In addition, hypotheses H_{13} and H_{15} were accepted when the t-values (5% level) were above 1.96. The other hypotheses were not shown to be significant at 5% confidence level.

Table 5.28 Summary of path coefficient and *t*-statistics for constructs

Path	Hypothesis	Path coefficient	*t*-statistics	Significance
Entrepreneurial type -> Entrepreneurial leadership capacity	H_1	0.4918	6.9651	***
Market orientation -> Entrepreneurial leadership capacity	H_2	0.2875	2.9012	***
Business climate -> Entrepreneurial leadership capacity	H_3	0.1188	1.2458	--
Environmental uncertainty -> Entrepreneurial leadership capacity	H_4	0.0999	0.9033	--
Competitive advantages -> Entrepreneurial leadership capacity	H_5	0.1169	1.295	--
Entrepreneurial leadership capacity -> Presence of opportunity	H_7	0.135	3.316	***
Entrepreneurial leadership capacity -> Opportunity recognition	H_8	0.5406	6.0853	***
Entrepreneurial leadership capacity -> Decision for opportunity exploitation	H_9	0.7648	7.7323	***
Entrepreneurial leadership capacity -> Resource acquisition	H_{10}	0.0711	0.5174	--
Entrepreneurial leadership capacity -> Process management for start-up	H_{11}	0.3388	4.0755	***
Entrepreneurial leadership capacity -> Enhanced organisational achievement	H_{12}	0.0388	6.455	***
Presence of opportunity -> Opportunity recognition	H_{13}	0.2543	2.1485	*
Opportunity recognition -> Decision for opportunity exploitation	H_{14}	-0.2788	1.7332	--
Decision for opportunity exploitation -> Resource acquisition	H_{15}	0.3425	2.1834	*
Resource acquisition -> Process management for start-up	H_{16}	0.3331	3.1186	**
Process management for start-up -> Enhanced organisational achievement	H_{17}	0.608	8.2192	***
Entrepreneurial type -> Presence of opportunity	H_{18}	0.0105	0.0514	--
Market orientation -> Presence of opportunity	H_{19}	0.062	0.4595	--
Business climate -> Presence of opportunity	H_{20}	0.2437	1.5578	--
Environmental uncertainty -> Presence of opportunity	H_{21}	-0.2026	1.3848	--
Competitive advantages -> Presence of opportunity	H_{22}	0.1418	0.8779	--

Note: * = $t > 1.96$ at $p < 0.05$; ** = $t > 2.576$ at $p < 0.01$, *** = $t > 3.29$ at $p < 0.001$ (based on $t_{39)}$, two-tailed test); “—“ = no significant difference

5.4 Discussion

This section presents the interpretations of the results obtained from the PLS analysis of Structural Equation Modelling (SEM) described in the previous section 5.3. This section details the hypothesis testing results inclusive of the direct effect in the EELC model. The results of the hypothesis testing are summarised in Tables 5.27 and 5.28.

The findings of the main survey will be discussed in detail in terms of the major research questions and the twenty one (21) research hypotheses in this study excluding H_6 and H_{23} due to the removal of low loading items. The proposed research model of EELC is also analysed by examining the direct effect of entrepreneurial type, external and internal drivers on entrepreneurial leadership capacity which would lead to entrepreneurial process and enhanced organisational achievement.

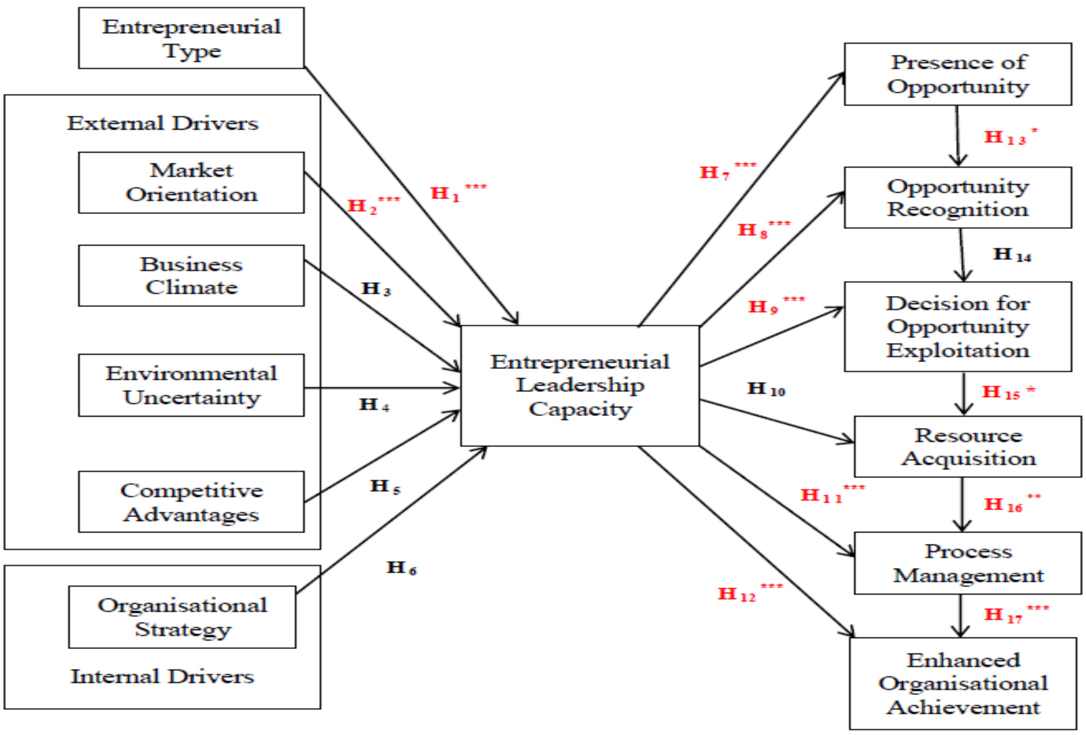
5.4.1 Interpretation of the Research Model

Hypothesis testing was performed in section 5.3 by examining the t-values and path coefficients. The results of the testing of hypotheses are detailed in Tables 5.27 and 5.28. The results of this study revealed that eleven (11) out of the twenty-one (21) hypotheses were accepted. Table 5.28 and Figure 5.4 list the hypotheses at various confidence levels (5%, 1% and 0.1%) that are significant in the EELC model. Those significant hypotheses are highlighted in red colour and levels of significance (5% (*), 1% (**) and 0.1% (***)).

It reveals that two hypotheses (H_1 & H_2) out of six hypotheses (H_1 – H_5) were statistically significant to entrepreneurial leadership capacity at 0.1% confidence level (***). These are 1) entrepreneurial type, and 2) market orientation. Among the next six (6) hypotheses (H_7 – H_{12}) in Figure 5.4, five hypotheses (H_7, H_8, $H_{9,}$

H_{11} and H_{12}) were statistically significant to presence of opportunity, resource acquisition, decision for opportunity exploitation, process management and enhanced organisational achievement at 0.1% confidence level (***), while one hypothesis (H_{10}) was not statistically significant to resource acquisition at 5% confidence level (*). In the next five hypotheses (H_{13} – H_{17}) for entrepreneurial steps and enhanced organisational achievement, presence of opportunity was statistically significant to opportunity recognition (H_{13}) at 5% confidence level (*), while opportunity recognition was not statistically significant to decision for opportunity exploitation (H_{14}) at 5% confidence level (*). Decision for opportunity exploitation was statistically significant to resource acquisition at 5% confidence level (*). In addition, resource acquisition was statistically significant to process management (H_{16}) at 1% confidence level (**), while process management was statistically significant to enhanced organisational achievement (H_{17}) at 0.1% confidence level (***).

Figure 5.4 Significant hypotheses in EELC model



Note: * = $t > 1.96$ at $p < 0.05$; ** = $t > 2.576$ at $p < 0.01$, *** = $t > 3.29$ at $p < 0.001$ (based on t_{39}), two-tailed test)

Finally, in Figure 3.4 in Chapter 3**,** next five (5) hypotheses (H_{18} **-** H_{22}**)** tested for the impact of the mediating role from entrepreneurial leadership capacity (ELC) between the independent variables (e.g. entrepreneurial type, market orientation, business climate, environmental uncertainty, competitive advantages and organisational strategy) and the dependent variable (presence of opportunity) in high-technology ventures. None of these five hypotheses was statistically significant to presence of opportunity which was predicted by the author. The role of entrepreneurial leadership capacity as the mediator is critical to enhance the pursuit of modes of exploitation in the presence of opportunity.

The following sub-sections will discuss each hypothesis in detail.

5.4.1.1 Entrepreneurial Type (H_1)

The research literature has emphasised the importance of the role of entrepreneur in the success of high technology ventures (Jones-Evans 1995; Gans & Stern 2003; Oakey 2003; Peng & Shekshnia 2001). Biotechnology is no exception to its impact with respect to the importance of the entrepreneurs (Oliver 2004; Deeds & Hill 1996).

Hypothesis H_1 was tested to explore the important role that entrepreneurial type related to entrepreneurial leadership capacity (ELC) plays in enhancing the pursuit of modes of exploitation in the entrepreneurial process with good business models and enterprise performance.

Hypothesis 1 (H_1)

The most appropriate entrepreneurial type is positively associated with entrepreneurial leadership capacity (ELC) in high-technology ventures

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In Tables 5.27 and 5.28, the role of entrepreneurial type (H_1) related to entrepreneurial leadership capacity (ELC) found to be statistically significant (β=0.4918, *t*-value=6.9651, $p<0.001$). Therefore, the hypothesis (H_1) was accepted. This finding indicated that entrepreneurial type is positively associated with entrepreneurial leadership capacity (ELC) in high-technology ventures.

This finding agrees with Ribeiro and Comeche (2007) that a strong entrepreneurial leader can make an organisation become more entrepreneurial as a whole. Effective leadership plays a critical role in the success of achieving company outcomes for various types and sizes of entrepreneurial firms (Daily, McDougall, Covin & Dalton 2002). The most appropriate entrepreneurial type is positively associated with ELC. In Figure 3.3, any of the four types of entrepreneurs (personal achiever (PA), expert idea generator (EI), super sales people (SS) and real manager (RM)) may become a leader (Miner 2000, Morris et al. 2000) with ELC. With ELC, the entrepreneurs are able to recognise and remove the innovation barriers and the presence of opportunity will be found successfully. Then innovative products or services can be invented or formulated for commercialisation in high-technology ventures.

As mentioned in Table 3.1 (Miner 1997), each entrepreneurial type with the distinct trait will have the tendency to pursue the preferred entrepreneurial success routes (*managing route, selling route, achieving route* and *idea generating route*) for high-technology ventures which he or she thinks is appropriate to follow. In addition, according to Tables 5.29 and 5.30 (Miner 1997), the personal achiever (PA) and expert idea generator (EI) entrepreneurs were capable of achieving performance and results but they were also strong in self-belief of their ideas and invention leading to self-centeredness in personality. Sometimes, venture capitalists may find the PA and EI entrepreneurs hard to work with because of these characteristics and decline to invest in their biotechnology firms. The other reason why venture capitalists do not invest in the biotechnology sector is the slow return from the long research and commercialisation processes. Although the PA and EI entrepreneurs are very strong in technical knowledge, they may have a poor understanding of the market needs and a lack of know-how for product commercialisation.

The more an entrepreneur's character demonstrates the entrepreneurial leadership capacity (ELC), the more likely it is that the entrepreneur will successfully find the presence of opportunity in high-technology ventures. ELC has influence between entrepreneurial types and modes of exploitation in high-technology ventures. Entrepreneurial types with ELC who are generally task-oriented, charismatic, have relentless drive and are inspirational to others, are also likely have the capacity to create and articulate a clear vision for an organisation, explore their environment and identify opportunities that could be exploited, while they show the leadership skills in motivating others with the built trust to actively participate in the entrepreneurial process towards value creation in high-technology industry.

Table 5.29 Characteristics of the personal achievers and super sales people in the four-way psychological typology

Entrepreneurial type	Characteristic	Description
Personal achievers (PA)	*Motivation for self-achievement	This factor was the very first characteristic being studied. Degree of achievement satisfaction can vary between individuals. Achieving for success is the major concern than avoiding failure. They prefer situations in which they can influence and have clear-cut individual responsibility.
	*Type A personality-achieve more in less time	The person can achieve more in less time. Not all type As are the same in the personality.
	*Desire for feedback on achievement	Certain kinds of people have the desire to be acknowledged about their level of performance which can be recognised as motivational effects
	*Desire to plan and set goals for future achievements	They tend to think and plan about the future with the personal goals for achievement.
	*Strong personal commitment to their ventures	They have a value-based identification with their ventures, e.g. a strong belief in and acceptance of the organisation's goals and values, a willingness to exert considerable effort on behalf of the organisation, and a strong desire to maintain membership in the organisation
	*Desire to obtain information and learn	They are very practical, hard-working and pragmatic to get any and all information to make the successful and efficient business.
	*Internal locus of control	It refers to the people's perception of the extent to which control over events resides within themselves internally. This makes planning possible and contributes to the formulation of effective strategies.
	High value placed on careers in which personal goals and work demand govern	These are people who believe a really good job is one where they set their own goals, strive to accomplish those goals as they see fit, and live or die by the extent to which they correctly figure out what the task requires.
	Low value placed on careers in which peer groups govern	They believe in personal causation and personal responsibility. One can clearly identify who did the work and who should get the credit in an ideal work situation.
	Strong personal initiative	They are self-starters who do not need assistance from others to accomplish their tasks.
Super sales people (SS)	*Capacity to understand and empathise others	They acquire information by sensing, listening, and interacting with people and they evaluate information by using their feelings and instincts. They have little tolerance for ambiguity. They have a talent for building teams and encourage participation at work.
	*Belief in the importance of social processes	They emphasis on the social interaction and relationships with other people. This can facilitate the sales process. This characteristic reflects the person's work values such as the importance of making a contribution to society, having pleasant and agreeable co-workers, being valued as a person, having the esteem of others, having the opportunity of meeting people and receiving recognition from others for doing a good job.
	*Desire to help others	They have the idea of enjoying being of service to and helping others. The desire to help others may come from a strong concern for others, a warm and understanding need to be of service and a sense of internal satisfaction by providing help instead of receiving it. Consumers are motivated to return the favour by buying the product.
	*Good at external relationship building	They need good relations to feel at ease and secure. Their self-esteem can be dependent on how other regard them and relate to them. They encourage others in participating in the decision-making process and welcome new ideas or different approach to a problem.
	*Belief in sales forces	They recognise a sale force to be an important means of implementing company strategies. Sales force is to be considered very important role among the other functions such as advertising, delivery, discounts, new product development, package, price, quality, reciprocity, reputation, services and variety.

Note: * Characteristics studied in the research by Miner (2000)

Source: Miner (1997)

Table 5.30 Characteristics of the expert idea generator and real manager in the four-way psychological typology

Entrepreneurial type	Characteristic	Description
Expert idea generator (EI)	*Desire to innovate personally	They enjoy coming up with new ideas and implement them. Original or novel or creative or innovative approaches are the distinct features.
	Build venture around new products	Mostly they are involved in developing new products and services. They consider that new product development is important to company's strategic positioning. This characteristic is very critical to the success of inventor-entrepreneurs and their firms.
	*Involved with high-tech companies (conceptual in cognitive style)	They love creative ideas and enjoy solving problems. They can tolerate high ambiguity and risk taking. They are insightful, adaptive, flexible and enthusiastic. They have strong desire for showing concerns for others, intuition, a need for independence and pursuit for personal goals. They prefer loose, decentralised organisational structures. They play an important role in determining how entrepreneurs approach their firms.
	*Intelligence as source of competitive advantage	This characteristic has very crucial role for expert idea generator. Intelligence is considered to involve such capabilities as judgment and reasoning, and the capacity to deal with ideas, abstractions, and concepts, the ability to learn, insightfulness, and the capacity to analyse and to synthesise.
	*Desire to avoid taking risks	This type of entrepreneur may be much more risk avoiders. Their enthusiasm for ideas and innovation may direct them into actions for threatening the venture. Avoiding risk is the counterforce to restrain this enthusiasm.
Real manager (RM)	*Positive attitudes towards authority	Good and effective managers will possess the positive attitudes towards authority. They should not provoke negative reactions from their superiors. They should be in a position to represent their units upward in the organisation and to obtain support for their actions at higher levels.
	*Desire to compete with others	For successful managers, they must compete for scarce rewards both for themselves and their groups. For those who enjoy doing so are likely to perform better in the pyramidal nature of hierarchic organisations.
	*Desire to assert oneself	Assertiveness appears to be part of managerial talent. Management prefers to have this type of person to be in charge, make decision, take disciplinary actions and make protection for others. They are proactive rather than reactive
	*Desire to exercise power and to be corporate leader	Managers need to exercise their power over subordinates and guide their behaviour in a manner consistent with organisational goals. Proper exercise of power and positive attitude to it can contribute to successful performance as a manager.
	*Directive in cognitive style	They focus on tasks, technical problems, giving particular attention to facts, rules and procedures. This kind of manager is impersonal and capable of using power to be forceful. They can fit well with structured, goal-oriented organisations where power and authority are used to get things done as quickly as possible.
	*Desire to stand out from the crowd	Persons who can stand out from the group and assume the position of high visibility can meet the role requirement as managers and proved to be effective in their work.
	*Desire to perform managerial tasks	These managers have the desire to perform the various routine activities in a responsible manner associated with managerial work. A good manager has the desire to do what the job requires.
	High supervisory ability	They have the capability to direct the work of others, and to organise and integrate their activities to meet the goals of organisation.
	Strong self-assurance	This characteristic provides the foundation and support which can enable the person to cope with problems during the confrontation. Faith in oneself is essential if a person has to act effectively.
	Strong need for occupational advancement	Some individuals are eager to achieve appointments to high-level positions. Such people with a strong desire for occupational advancement should be motivated to perform better as higher managerial levels in the organisation
	Strong need for self-actualisation	Some people will try their best to seek opportunity to utilise their talents to the fullest extent but not leaving their capabilities to be unfulfilled. Self-actualisation is extremely critical for high-level managerial work. Managerial effectiveness becomes their goal to achieve self-actualisation.
	Weak need for job security	Those best performance managers will not have a sense of job insecurity because they have a weak need for job security. Otherwise they will be attracted to the management role.
	Strong personal decisiveness	Good managers must exhibit the strong personal decisiveness based on very limited information. Otherwise serious consequences will lead to the disruption of corporate operation.

Note: * Characteristics studied in the research by Miner (2000)

Source: Miner (1997)

For those successful high-technology organisations such as biotechnology companies, studies have demonstrated the co-importance of entrepreneurial leadership abilities/capacity or skills, as well as product ideas and/or technology (Foller 2002), the influence of leadership on creative knowledge environments for research groups (Hemlin 2006) and the lack of leadership, as the primary inhibitor for the progress in biotechnology instead of only technology factors (Tweed & McGregor 2004).

Essentially, this new model of entrepreneurship (EELC) suggests that the role of entrepreneurial leadership ability/capacity as the mediator is a key determining factor for success between entrepreneurial types and modes of opportunity exploitation in the entrepreneurial process with good business models and enterprise performance in high-technology ventures. It also shows that entrepreneurial types (PA, EI, SS and RM) who have successfully incorporated the entrepreneurial leadership ability/capacity can create competitive advantages for the firms to achieve excellence in which competitors will find difficult to understand and imitate.

5.4.1.2 Market Orientation (H_2)

Market orientation has characteristic as "the cyclic process of information acquisition about an organisation's environment, the distribution and interpretation within the organisation of this intelligence, and the organisation's responsive action" (Renko, Carsrud & Brännback 2009). Slater and Narver (1995) also comment that appropriate organisational processes coupled with an entrepreneurial spirit are necessary for an effective market orientation.

Hypothesis H_2 was tested to explore the important role that marketing orientation related to entrepreneurial leadership capacity (ELC) plays in enhancing the pursuit of modes of exploitation in the entrepreneurial process with good business models and enterprise performance.

Hypothesis 2 (H_2)

Market orientation is positively associated with entrepreneurial leadership capacity (ELC) in high-technology ventures

In Tables 5.27 and 5.28, the role of market orientation (H_2) related to entrepreneurial leadership capacity (ELC) found to be statistically significant (β=0.2875, *t*-value=2.9012, $p<0.001$). Therefore, the hypothesis (H_2) was accepted. This hypothesis confirms that market orientation is positively associated with ELC. With ELC, the conditions in market orientation help recognise the innovation barriers and promote the type of innovation which are needed in high-technology ventures.

This finding agrees with Matsuno, Mentzer, and Ozsomer (2002), Slater and Narver (1995), and Becherer, Halstead and Haynes (2001). Matsuno et al. (2002) suggest that the greater the level of entrepreneurial proclivity, the greater the level of market orientation. In this sense, organisations with higher levels of market orientation tend to place more emphasis on entrepreneurship (Matsuno et al. 2002). Besides, since small companies are more responsive and pro-active towards market orientation (Becherer, Halstead & Haynes 2001), it would therefore appear that proactive entrepreneurs could use market orientation as a mechanism to reduce risk. The adoption of entrepreneurship in organisations enables organisations to identify the latent needs of customers and innovative ways to address their existing needs. A primary entrepreneurial activity is not only to create better products than competitors but also to lead the industry in recognising customers' evolving needs (Slater & Narver 1995). Thus, an integrated market orientation with its focus on understanding both expressed and latent customer needs is inherently entrepreneurial (Slater & Narver 1995).

5.4.1.3 Business Climate (H_3)

An economy is said to have a sound business climate when it dwells in stability and openness in economic and political policies, has efficient, transparent and effective governance and regulatory systems. and availability of the required infrastructure to support economic activities to grow and thrive. A sound business climate encourages investments and entrepreneurship needed for growth and development (Mensah 2012).

Hypothesis H_3 was tested to explore the important role that business climate related to ELC plays in enhancing the pursuit of modes of exploitation in the entrepreneurial process with good business models and enterprise performance.

Hypothesis 3 (H_3)

Business climate is positively associated with entrepreneurial leadership capacity (ELC) in high-technology ventures

In Tables 5.27 and 5.28, the role of business climate (H_3) related to entrepreneurial leadership capacity (ELC) found to be non-statistically significant (β=0.1188, *t*-value=1.2458) at three confidence levels. Therefore, the hypothesis (H_3) was rejected. This finding showed that the business climate is not positively associated with ELC in high-technology ventures.

The lack of evidence to support Hypothesis H_3 indicated that there is no positive association between business climate and ELC. That was why the author could find hardly any research articles on the relationship between business climate and entrepreneurial leadership. This confirms that there is no impact from business climate on ELC.

5.4.1.4 Environmental Uncertainty (H_4)

Environmental uncertainty has also been defined as an inability to anticipate fast changes in economic conditions (Dess & Beard 1984; Krishnan et al. 2006). It has even been described as unpredictability or instability in the markets (Aldrich 1979) or technological fields (Moorman & Miner 1997) which requires significant scanning of the industrial condition in order to acquire accurate and reliable information.

Hypothesis H_4 was tested to explore the important role that environmental uncertainty related to entrepreneurial leadership capacity (ELC) plays in enhancing the pursuit of modes of exploitation in the entrepreneurial process with good business models and enterprise performance.

Hypothesis 4 (H_4)

Environmental uncertainty is positively associated with entrepreneurial leadership capacity (ELC) in high-technology ventures

In Tables 5.27 and 5.28, the role of environmental uncertainty (H_4) related to ELC found to be non-statistically significant (β=0.0999, *t*-value=0.9033) at three confidence levels. Therefore, the hypothesis (H_4) was rejected. This finding indicated that environmental uncertainty is not positively associated with entrepreneurial leadership capacity (ELC) in high-technology ventures.

This finding was contradictory with the prediction of the studies by Gartner and Liao (2007); Liao and Gartner (2006); Gartner and Liao (2012) and Krishnan et al. (2006). Gartner and Liao (2007), and Liao and Gartner (2006) found that perceptions of environmental uncertainty played an important role in differentiating between nascent entrepreneurs who were more likely to engage in preventive planning, or not. Based on those findings, they surmised that differences in perceptions of environmental uncertainty would likely influence differences in risk perceptions among nascent entrepreneurs, as well (Gartner & Liao 2012). In addition, environmental uncertainty has a contingent value (Krishnan et al. 2006) and suggests that high innovative performance results from the fit between the strategic posture of the new venture and the environmental factor.

The possible explanation for the non-significance of the positive relationship between environmental uncertainty and entrepreneurial leadership capacity (ELC) is from the different environmental factors between those previous studies and the surveyed Australian biotechnology industry in this study. Environmental uncertainty is situational depending on the nature of the industry, for example, political infrastructure in society, legal infrastructure, regulatory infrastructure, socio-cultural infrastructure and financial infrastructure (Morris et al. 2000; Spekman & Stern 1979). Those previous studies were not conducted in biotechnology industry which would not provide the same predictions from different innovation barriers for commercialisation of products.

5.4.1.5 Competitive Advantages (H_5)

An enterprise ought to choose a proper industrial position, to make its competitive pressure lighter, or to adopt some actions on its rival firms to earn its own benefits (Porter 1985). Firms can enhance their chances for survival, growth, competitiveness and profitability by implementing strategies to gain competitive advantage.

Hypothesis H_5 was tested to explore the important role that competitive advantages related to ELC plays in enhancing the pursuit of modes of exploitation in the entrepreneurial process with good business models and enterprise performance.

Hypothesis 5 (H_5)

Competitive advantages are positively associated with entrepreneurial leadership capacity (ELC) to successfully find the presence of opportunity in high-technology ventures

In Tables 5.27 and 5.28, the role of competitive advantages (H_5) related to entrepreneurial leadership capacity (ELC) found to be non-statistically significant (β=0.1169, *t*-value=1.295) at three confidence levels. Therefore, the hypothesis (H_5) was rejected. This finding confirmed that competitive advantages are not positively associated with entrepreneurial leadership capacity (ELC) in high-technology ventures.

This finding was not consistent with Newbert, Gopalakrishnan and Kirchhoff (2008), and Lee & Hsieh (2010) findings. Entrepreneurs can take the changes in environment as normal situations and try to utilise the opportunities in environments. The risks of starting a business mainly come from the fact that only a few persons have the idea and the spirit of entrepreneurship. Entrepreneurs can find the source of innovation, the changes of environment, and clue of opportunity in the environment, and can understand the principle of successful innovation and use it (Newbert, Gopalakrishnan & Kirchhoff 2008). Entrepreneurship is an important influencing factor for sustained competitive advantage (Lee & Hsieh 2010).

The possible explanation for the non-significance of the positive relationship between competitive advantages and entrepreneurial leadership capacity (ELC) is from the nature of ELC. From the list of measure instruments of competitive advantages in Figure 3.3, ELC can influence the instruments of the barriers to entry for proprietary protection and product differentiation but have no controls over low fixed and variable costs of production/marketing/distribution, moderate to strong degree of control for prices/costs/channels of supply etc. and barriers to entry for lead time/legal advantage. Since the majority of uncontrollable instruments are covered by ELC, competitive advantages can hardly have a positive relationship with ELC.

5.4.1.6 Organisational Strategy (H_6)

This hypothesis was not tested due to the removal of low loading items.

5.4.1.7 Relationship of Entrepreneurial Leadership Capacity and Entrepreneurial Process (H_7 to H_{11})

Among the next six (6) hypotheses (H_7 – H_{12}) in Figure 5.4, five hypotheses (H_7, H_8, H_9, H_{11} and H_{12}) were statistically significant to presence of opportunity, resource acquisition, decision for opportunity exploitation, process management and enhanced organisational achievement at 0.1% confidence level (***) while one hypothesis (H_{10}) was not statistically significant to resource acquisition at 5% confidence level (*).

<u>Presence of Opportunity</u>

The presence of entrepreneurial opportunity occurs when there are changes in technology, economic, political, regulatory, demographic, or social conditions (Ardichvili, Cardozo & Ray 2003). The other reasons why some people can discover opportunities easier than others are better access to information about the existence of the opportunity due to their previous life experience, social network structure and information search; and better personal capability with absorptive capacity and cognitive processes given the same amount of information (Kirzner 1997).

Hypothesis H_7 was tested to explore the important role that entrepreneurial leadership capacity (ELC) related to presence of opportunity plays in enhancing the pursuit of modes of exploitation in the entrepreneurial process with good business models and enterprise performance.

<u>Hypothesis 7 (H_7)</u>

Successful deployment of entrepreneurial leadership capacity (ELC) is more likely to find the presence of opportunity in high-technology ventures

In Tables 5.27 and 5.28, the role of ELC (H_7) related to presence of opportunity found to be statistically significant (β=0.135, *t*-value=3.316, p<0.001). Therefore, the hypothesis (H_7) was accepted. This finding indicated that successful deployment of ELC is more likely to find the presence of opportunity in high-technology ventures.

From the literature review, there are not many researchers who studied the relationship between leadership and the entrepreneurial process. The aim of this EELC model intends to explore this relationship. With the recognition of innovation barriers and the types of innovation included in the ELC, the entrepreneurs will have the ability to find the presence of opportunities easier than others who do not have better access to information about the existence of the opportunity.

"Successful leadership has been found to be based upon four key strategies: attention through vision, meaning through communication, trust through positioning, and confidence through respect" (Darling, Gabrielsson & Seristo 2007). One of the key strategies for successful leadership is the exercise of communication for explaining the meaning of the vision of how to pursue the entrepreneurial success route. Communicating with others is crucial for entrepreneurial leaders (Darling & Beebe 2007). Effective communication about the recognised opportunities through the dynamics of an organisational setting is particularly important to successful entrepreneurial leadership. Entrepreneurs with

ELC will strive to support colleagues for loyalty and motivation that will serve to enhance the continued achievement of organisational excellence and the operational success of that organisation (Darling, Keeffe & Ross 2007). This phenomenon illustrates that ELC also influences the speed of achieving good organisational performance. From this, it implies that ELC/capacity can speed up the rate of pursuing modes of exploitation in high-technology ventures.

Based on their characteristics, personal achiever (PA) and expert idea generator (EI) entrepreneurs will choose the "*achieving route*" and "*idea generating route*" for entrepreneurial success as shown in Table 3.1 (Miner 1997). Personal achievers (PA) are achievement-focused, successful in entrepreneurship, hard-working, driven for results and struggling everywhere else. The expert idea generators (EI) focus more on finding a solution than how that solution may help the customer. EI are characterised by the desire to innovate and be creative, the intention to avoid risk taking and a high level of intelligence. Since EI tends to focus on ideas and concept, they may bring in those new products and services to the market in which they are interested but which the market does not need. The other danger that EI may run into is the crippling of their capacity to function during the start-up phase of venture growth because of their unwillingness in taking risks in uncertain situations.

In Table 3.1, because of the characteristics of super sales people (SS) and real manager (RM) entrepreneurs, they will prefer to choose the "*selling route*" and "*managing route*" for entrepreneurial success (Miner 1997). SS entrepreneurs are considered as very customer-oriented, willing to help others and sociable. They are eager to understand client needs and always find ways to meet these needs.

Real manager (RM) entrepreneurs have the desire to compete, be assertive and stand out for their success. They demonstrate positive attitudes towards authority by complying with rules and policies (Miner 1997). Since RM entrepreneurs with ELC/ ability do not have the same strong need for personal achievement and creativity as PA and EI entrepreneurial types do, they are less likely to successfully pursue modes of exploitation in high-technology ventures due to the lack of understanding of a technical nature and complexity of the industry. Some RM entrepreneurs with ELC/ ability can build collaborative teams, but they choose not to become entrepreneurs for pursuing the opportunity exploitation because they are more comfortable working as managers in large organisations (Miner 1997). These RM entrepreneurs may find the start-up phase of a new venture too challenging to cope with and not enjoyable.

Opportunity Recognition

Various modes of exploitation depend on the nature of the organisation in that industry, the opportunity and the individual entrepreneur difference (Shane & Venkataraman 2000; Shane 2003).

Hypothesis H_8 was tested to explore the important role that entrepreneurial leadership capacity (ELC) related to opportunity recognition plays in enhancing the pursuit of modes of exploitation in the entrepreneurial process with good business models and enterprise performance.

Hypothesis 8 (H_8)

Successful deployment of entrepreneurial leadership capacity (ELC) is more likely to recognise the opportunity in high-technology ventures

In Tables 5.27 and 5.28, the role of entrepreneurial leadership capacity (ELC) (H_8) related to opportunity recognition found to be statistically significant (β=0.5406, *t*-value=6.0853, $p<0.01$). Therefore, the hypothesis (H_8) was accepted. This finding confirmed that successful deployment of ELC is more likely to recognise the opportunity in high-technology ventures.

From the literature review, there are not many researchers who studied the relationship between leadership and the entrepreneurial process. The aim of this EELC model intends to explore this relationship. With the recognition of innovation barriers and the types of innovation included in the ELC, the entrepreneurs will have the ability to recognise opportunities (e.g. changing demographics, emergence of new market segments, new process needs, new technologies, incongruities/lack of harmony, regulatory change and social change) easier than others who do not have better access to information about the opportunity.

Decision for Opportunity Exploitation

Among the psychological factors of aspects of personality and motives, core self-evaluation and cognitive properties (Shane 2003), or consideration of the motivations of people has the significance of influencing the entrepreneurial decisions for opportunity exploitation (Shane, Locke & Collins 2003). Individual differences in motivation can vary the willingness and ability of others to make decisions for exploiting the opportunities in the entrepreneurial process.

Hypothesis H_9 was tested to explore the important role that ELC related to decision for opportunity exploitation plays in enhancing the pursuit of modes of exploitation in the entrepreneurial process with good business models and enterprise performance.

Hypothesis 9 (H_9)

Successful deployment of entrepreneurial leadership capacity (ELC) is more likely to decide for opportunity exploitation in high-technology ventures

In Tables 5.27 and 5.28, the role of entrepreneurial leadership capacity (ELC) (H_9) related to decision for opportunity exploitation found to be non-statistically significant (β=0.7648, *t*-value=7.7323, $p<0.01$). Therefore, the hypothesis (H_9) was accepted. This finding confirmed that successful deployment of entrepreneurial leadership capacity (ELC) is more likely to decide for opportunity exploitation in high-technology ventures.

From the literature review, there are not many researchers who studied the relationship between leadership and the entrepreneurial process. The aim of this EELC model intends to explore this relationship. Even with the recognition of innovation barriers and the types of innovation included in the ELC, the entrepreneurs will not have the ability to make the decision easier and faster for opportunity exploitation in high-technology ventures. The lack of evidence to support Hypothesis H_9 may be due to the long R&D and commercialisation time for a new product to be launched in the biotechnology industry, which makes the entrepreneurs have to think very carefully in decision-making for opportunity exploitation.

Resource Acquisition

Both financial and non-financial resources are required to pursue successful entrepreneurship. A lot of emphasis is placed on obtaining sufficient financial capital for business launching. However, there are still a lot of cases of failure even when entrepreneurs have sufficient financing. Non-financial resources such as the information about markets, environmental and legal issues; human resources for hiring the right kind of employees with skills, knowledge, motivation and drive for success are also very critical (Shane 2003).

Hypothesis H_{10} was tested to explore the important role that ELC related to resource acquisition plays in enhancing the pursuit of modes of exploitation in the entrepreneurial process with good business models and enterprise performance.

Hypothesis 10 (H_{10})

Successful deployment of entrepreneurial leadership capacity (ELC) is more likely to acquire the resources in high-technology ventures

In Tables 5.27 and 5.28, the role of ELC (H_{10}) related to resource acquisition found to be non-statistically significant (β=0.0711, *t*-value=0.5174) at three confidence levels. Therefore, the hypothesis (H_{10}) was rejected. This finding showed that resource acquisition is not positively associated with ELC in high-technology ventures.

With the recognition of innovation barriers and the types of innovation included in the ELC, the entrepreneurs will not have the ability to know what kinds of resources needed to be acquired in high-technology ventures.

Process Management

Process management can ensure a process with explicit goals which guide the employees to perform consistently and managers to improve it in a disciplined way. Process management engages the organising activities for the exploitation of entrepreneurial opportunities in the process. In order to exploit the recognised opportunity for which the resources have been assembled, the entrepreneur has to implement process management to ensure the smoothness or the effectiveness of the entrepreneurial process.

Hypothesis H_{11} was tested to explore the important role that entrepreneurial leadership capacity (ELC) related to process management plays in enhancing the pursuit of modes of exploitation in the entrepreneurial process with good business models and enterprise performance.

Hypothesis 11 (H_{11})

Successful deployment of entrepreneurial leadership capacity (ELC) is more likely to have start-up process management in high-technology ventures

In Tables 5.27 and 5.28, the role of ELC (H_{11}) related to process management found to be statistically significant (β=0.3388, *t*-value=4.0755, $p<0.01$). Therefore, the hypothesis (H_{11}) was accepted. This finding confirmed that successful deployment of entrepreneurial leadership capacity (ELC) is more likely to have start-up process management in high-technology ventures.

From the literature review, there are not many researchers who studied the relationship between leadership and the entrepreneurial process. The aim of this EELC model intends to explore this relationship. Even with the recognition of innovation barriers and the types of innovation included in the ELC, the entrepreneurs will not have the ability to monitor the process management much better by demonstrating the entrepreneurial leadership skills in high-technology ventures. The lack of evidence to support Hypothesis H_{11} may be due to the lack of years of leadership experience the entrepreneurs have to manage the start-up effectively and efficiently.

5.4.1.8 Relationship of Entrepreneurial Leadership Capacity and Enhanced Organisational Achievement (H_{12})

Enhanced Organisational Achievement

In this new model of EELC, business models and enterprise performance as the enhanced organisational achievement are being studied in high-technology industry. As a viable company for enhanced organisational achievement, preparing business models can help the entrepreneur formulate good organisational strategies with specific goals leading to better enterprise performance.

Hypothesis H_{12} was tested to explore the important role that ELC related to enhanced organisational achievement plays in enhancing the pursuit of modes of exploitation in the entrepreneurial process with good business models and enterprise performance.

Hypothesis 12 (H_{12})

Successful deployment of entrepreneurial leadership capacity (ELC) is more likely to have enhanced organisational achievement (business models and enterprise performance) in high-technology ventures

In Tables 5.27 and 5.28, the role of ELC (H_{12}) related to enhanced organisational achievement (business models and enterprise performance) found to be statistically significant (β=0.0388, *t*-value=6.455, $p<0.001$). Therefore, the hypothesis (H_{12}) was accepted. This finding confirmed that successful deployment of ELC is more likely to have enhanced organisational achievement (business models and enterprise performance) in high-technology ventures.

With the recognition of innovation barriers and the types of innovation included in the ELC, the entrepreneurs will have the ability to achieve enhanced organisational achievement with good business models and satisfactory enterprise performance in high-technology ventures.

In Table 3.1 (Miner 1997), each entrepreneurial type with the distinct trait will have the tendency to pursue the preferred entrepreneurial success routes (*managing route, selling route, achieving route* and *idea generating route*) for high-technology ventures which he or she thinks is appropriate to follow. Once the start-up is formed, the entrepreneurial type with the ELC/ability will have the choices to adopt the appropriate business models such as strategic alliance with partners, refocussed current product development, launching of new products, raised public capital, raised private capital, and mergers and acquisition (Morris et al. 2005). Each entrepreneurial type (PA, SS, EI and RM) should be able to utilise the characteristics of entrepreneurial success route in the right environment of entrepreneurial start-up to implement the preferred business model. One of the popular business models to raise funds is via Initial Public Offering (IPO). Because of the limited private funds available, a lot of biotechnology firms rely on IPO for publicly raised money for the next phase of company expansion or product commercialisation (Gao, Darroch & Mather 2008).

For enterprise performance, the situation will be very similar to business models. When the start-up firm is formed, the entrepreneurial type (PA, SS, EI and RM) with the entrepreneurial leadership ability/capacity will follow the adopted business models to operate the firm with excellent enterprise performance such as managerial skills, efficiency/speed of product development, skilled labour, quality of product, marketing capability and collaboration with universities/research centres (Hall & Bagchi-Sen 2002). Each entrepreneurial type should be able to utilise the characteristics of entrepreneurial success route (*managing route, selling route, achieving route* and *idea generating route*) (Miner 1997) in the right environment of entrepreneurial start-up to operate the preferred business model with maximised business performance. The explanation of reasons for PA, EI, SS and RM about enterprise performance is very similar to the explanation of business models.

In summary, the entrepreneur with ELC will influence the modes of opportunity exploitation with appropriate business models and satisfactory enterprise performance as the enhanced organisational achievement in high-technology ventures.

5.4.1.9 Relationship of Entrepreneurial Process and Enhanced Organisational Achievement (H_{13} to H_{17})

The Entrepreneurial Process for Venture Growth

Baron and Shane (2005) refer to entrepreneurship as a process that takes place in distinct but closely interrelated phases over time for venture growth. The entrepreneurial process is considered to be the inclusion of all the functions, activities and actions in perceiving opportunities and creating organisations in the pursuit of profit (Bygrave & Zacharakis 2008).

In this proposed new model of EELC, the five entrepreneurial steps are: presence of opportunity; opportunity recognition; decision for opportunity exploitation; resource acquisition and process management. As shown in Tables 5.27 and 5.28 for these five hypotheses (H_{13} – H_{17}) for entrepreneurial steps and enhanced organisational achievement, presence of opportunity was statistically significant to opportunity recognition (H_{13}) at 5% confidence level (*) while opportunity recognition was not statistically significant to decision for opportunity exploitation (H_{14}) at 5% confidence level (*). However, decision for opportunity exploitation was statistically significant to resource acquisition (H_{15}) at 5% confidence level (*). In addition, resource acquisition was statistically significant to process management (H_{16}) at 1% confidence level (**), while process management was statistically significant to enhanced organisational achievement (H17) at 0.1% confidence level (***). The individual hypothesis is referred as follows.

Hypothesis H_{13} was tested to explore the important role that presence of opportunity related to opportunity recognition plays in enhancing the pursuit of modes of exploitation in entrepreneurial process with good business models and enterprise performance.

Hypothesis 13 (H_{13})

Presence of opportunity will positively influence the opportunity recognition in high-technology ventures

In Tables 5.27 and 5.28, the role of presence of opportunity (H_{13}) related to opportunity recognition found to be statistically significant (β=0.2543, *t*-value=2.1485, p<0.05). Therefore, the hypothesis (H_{13}) was accepted. This finding confirmed that presence of opportunity will positively influence the opportunity recognition in high-technology ventures.

Hypothesis H_{14} was tested to explore the important role that opportunity recognition related to decision for opportunity exploitation plays in enhancing the pursuit of modes of exploitation in the entrepreneurial process with good business models and enterprise performance.

Hypothesis 14 (H_{14})

Opportunity recognition will positively influence the decision for opportunity exploitation in high-technology ventures

In Tables 5.27 and 5.28, the role of opportunity recognition (H_{14}) related to decision for opportunity exploitation found to be non-statistically significant (β=- 0.2788, *t*-value=1.7332) at three confidence levels. Therefore, the hypothesis (H_{14}) was rejected. This finding confirmed that opportunity recognition does not positively influence the decision for opportunity exploitation in high-technology ventures.

Hypothesis H_{15} was tested to explore the important role that decision for opportunity exploitation related to resource acquisition plays in enhancing the pursuit of modes of exploitation in the entrepreneurial process with good business models and enterprise performance.

Hypothesis 15 (H_{15})

Decision for opportunity exploitation will positively influence the resource acquisition in high-technology ventures

In Tables 5.27 and 5.28, the role of decision for opportunity exploitation (H_{15}) related to resource acquisition was found to be statistically significant (β=0.3425, *t*-value=0.9514, p<0.05). Therefore, the hypothesis (H_{15}) was accepted. This finding indicated that decision for opportunity exploitation will positively influence the resource acquisition in high-technology ventures.

Hypothesis H_{16} was tested to explore the important role that resource acquisition related to process management plays in enhancing the pursuit of modes of exploitation in the entrepreneurial process with good business models and enterprise performance.

Hypothesis 16 (H_{16})

Resource acquisition will positively influence the start-up process management in high-technology ventures

In Tables 5.27 and 5.28, the role of resource acquisition (H_{16}) related to process management found to be statistically significant (β=0.3331, *t*-value=3.1186, p<0.1). Therefore, the hypothesis (H_{16}) was accepted. This finding confirmed that resource acquisition will positively influence the start-up process management in high-technology ventures.

Hypothesis H_{17} was tested to explore the important role that process management related to enhanced organisational achievement plays in enhancing the pursuit of modes of exploitation in the entrepreneurial process.

Hypothesis 17 (H_{17})

Start-up process management will positively influence the enhanced organisational achievement (business models and Enterprise performance) in high-technology ventures

In Tables 5.27 and 5.28, the role of process management (H_{17}) related to enhanced organisational achievement found to be statistically significant (β=0.608, *t*-value=8.2192, $p<0.001$). Therefore, the hypothesis (H_{17}) was accepted. This finding confirmed that start-up process management will positively influence the enhanced organisational achievement (business models and enterprise performance) in high-technology ventures.

In summary, entrepreneurial leaders who have the entrepreneurial leadership capacity (ELC), previous experience or capability in working through the entrepreneurial process, are capable of exploring their environments, identifying opportunities with exploitation and motivating participants actively in the process of value creation for entrepreneurship. Based on this, the possession of entrepreneurial leadership capacity from individual entrepreneur types (personal achiever (PA), expert idea generator (EI), super sales people (SS) and real manager (RM)) can enhance the modes of exploitation in the entrepreneurial process for venture growth in major industries like biotechnology industry.

5.4.1.10 Additional Hypotheses (H_{18} to H_{22})

In Figure 3.4 in Chapter 3**,** the next six (6) hypotheses (H_{18} - H_{22}) were tested for the impact of the mediating role from ELC between the independent variables (entrepreneurial type, market orientation, business climate, environmental uncertainty, competitive advantages and organisational strategy) and the dependent variable (presence of opportunity) in high-technology ventures. These six hypotheses (H_{18} - H_{22}) tested in the absence of the mediator "Entrepreneurial Leadership Capacity", whether each independent variable would have positive associations with the construct "Presence of Opportunity" which is the beginning of the entrepreneurial process for high-technology ventures. None of these six hypotheses was statistically significant to "Presence of Opportunity". From the result, the role of entrepreneurial leadership capacity as the mediator is confirmed to be critical to enhance the pursuit of modes of exploitation in the presence of opportunity.

Hypothesis H_{18} was tested to explore the important role that entrepreneurial type related to presence of opportunity plays in enhancing the pursuit of modes of exploitation in the entrepreneurial process with good business models and enterprise performance.

Hypothesis 18 (H_{18}):

The most appropriate entrepreneurial type is more likely to find the presence of opportunity in high-technology ventures

In Tables 5.27 and 5.28, the role of entrepreneurial type (H_{18}) related to presence of opportunity found to be non-statistically significant (β=0.0105, *t*-value=0.0514) at three confidence levels. Therefore, the hypothesis (H_{18}) was rejected. This finding showed that the most appropriate entrepreneurial type is not more likely to find the presence of opportunity in high-technology ventures.

Hypothesis H_{19} was tested to explore the important role that market orientation related to presence of opportunity plays in enhancing the pursuit of modes of exploitation in the entrepreneurial process with good business models and enterprise performance.

Hypothesis 19 (H_{19}):

Market orientation is positively associated with the presence of opportunity in high-technology ventures

In Tables 5.27 and 5.28, the role of market orientation (H_{19}) related to presence of opportunity found to be non-statistically significant (β=0.062, *t*-value=0.4595) at three confidence levels. Therefore, the hypothesis (H_{19}) was rejected. This finding confirmed that market orientation is not positively associated with the presence of opportunity in high-technology ventures.

Hypothesis H_{20} was tested to explore the important role that business climate related to presence of opportunity plays in enhancing the pursuit of modes of exploitation in the entrepreneurial process with good business models and enterprise performance.

Hypothesis 20 (H_{20}):

Business climate is positively associated with the presence of opportunity in high-technology ventures

In Tables 5.27 and 5.28, the role of business climate (H_{20}) related to presence of opportunity found to be non-statistically significant (β=0.2437, *t*-value=1.5578) at three confidence levels. Therefore, the hypothesis (H_{20}) was rejected. This finding confirmed that the business climate is not positively associated with the presence of opportunity in high-technology ventures.

Hypothesis H_{21} was tested to explore the important role that environmental uncertainty related to presence of opportunity plays in enhancing the pursuit of modes of exploitation in the entrepreneurial process with good business models and enterprise performance.

Hypothesis 21 (H_{21}):

Environmental uncertainty is positively associated with the presence of opportunity in high-technology ventures

In Tables 5.27 and 5.28, the role of environmental uncertainty (H_{21}) related to presence of opportunity found to be non-statistically significant (β=0.3599, *t*-value=2.5384) at three confidence levels. Therefore, the hypothesis (H_{21}) was rejected. This finding confirmed that environmental uncertainty is not positively associated with the presence of opportunity in high-technology ventures.

Hypothesis H_{22} was tested to explore the important role that competitive advantages related to presence of opportunity plays in enhancing the pursuit of modes of exploitation in the entrepreneurial process with good business models and enterprise performance.

Hypothesis 22 (H_{22}):

Competitive advantages are positively associated with the presence of opportunity in high-technology ventures

In Tables 5.27 and 5.28, the role of competitive advantages (H_{22}) related to presence of opportunity found to be non-statistically significant (β=0.1418, *t*-value=0.8779) at three confidence levels. Therefore, the hypothesis (H_{22}) was rejected. This finding confirmed that competitive advantages are not positively associated with the presence of opportunity in high-technology ventures.

Hypothesis H_{23} was not tested due to the removal of low loading items.

In summary, from the result of this study, entrepreneurial type and market orientation are the two important factors/drivers affecting the ELC and the entrepreneurial process. The role of entrepreneurial leadership capacity as the mediator is confirmed to be critical to enhance the pursuit of modes of entrepreneurial exploitation in the presence of opportunity.

5.5 Chapter Summary

Survey data acquired through the questionnaire survey were analysed. First, the result section has a summary of the key demographics and the mean of the respondents was demonstrated. Then the major results from the questionnaire were summarised. Second, for the purpose of study, the data were prepared and analysed statistically with Partial Least Squares Path Modeling (PLS-PM) for Structural Equation Modeling (SEM). Third, Section 5.3 details the data analysis section of the study of the new model of EELC. It discusses the results of the SEM-based Partial Least Squares (PLS) analysis of the quantitative data. The PLS framework was used to evaluate the measurement model for item reliability, internal consistency, internal consistency and discriminant validity. This is followed by the analysis of the structural model using a bootstrapping procedure to evaluate the significance of the paths (hypothesis testing) in the model and to measure the explained variance, R^2. Fourth, the discussion interprets the research model by analysing the twenty-three (23) hypotheses testing in detail.

Two stages (assessment of measurement model and assessment of structural model) of PLS assessment procedure were conducted. The evaluation criteria for these two stages can be found in Table 4.7 in Chapter 4.

In the assessment of the structural model, the R for observed variables tell how well the observed variables measure their underlying latent constructs both individually and as a group. It is calculated as the square of observed variable's standardised SmartPLS loading. The R for the structural equation reflects the proportion of variance of dependent variables explained by the variables in the structural equation (Ringle et al. 2005). The values of R range from 0 to 1. Table 5.26 shows the R values for the main EELC model. It shows that the model explains 44% (R^2=0.44) of the variance in Entrepreneurial Leadership Capacity, 23% (R^2=0.23) of the variance in Presence of Opportunity, 42% (R^2=0.42) of the variance in Opportunity Recognition, 41% (R^2=0.41) of the variance in Decision for Opportunity Exploitation, 13% (R^2=0.13) of the variance in Resource Acquisition, 29% (R^2=0.29) of the variance in Process Management for Start-up and 39% (R^2=0.39) of the variance in Enhanced Organisational Achievement.

In this study, the PLS results show that the model exhibits explanatory power in the neighbourhood of 44% in the Entrepreneurial Leadership Capacity. It means that the model explained 44% of the variance in the Entrepreneurial Leadership Capacity, which is reasonably good (Holmes-Smith 2001).

The twenty-three (23) hypotheses were tested based on Figure 3.4 in Chapter 3.

Besides the seventeen hypotheses (H_1 - H_{17}**)** to test the proposed new EELC model, the next six (6) hypotheses (H_{18} - H_{23}**)** will test the impact of the mediator role from entrepreneurial leadership capacity (ELC) between the independent variables (entrepreneurial type, market orientation, business climate, environmental uncertainty, competitive advantages and organisational strategy) and the dependent variable (presence of opportunity) in high-technology ventures (Figure 3.4 in Chapter 3). These six hypotheses (H_{18} - H_{23}**)** will test, in the absence of the mediator "Entrepreneurial Leadership Capacity", whether each independent variable will have positive association with the construct "Presence of Opportunity" which is the beginning of entrepreneurial process for high-technology ventures (Figure 3.4). However, H_6 and H_{23} were not tested due to the deletion of low loading of items.

The results of the testing of hypotheses are detailed in Tables 5.27 and 5.28. The results of this study revealed that eleven (11) out of the twenty-one (21) hypotheses were accepted. Table 5.28 and Figure 5.4 list out the hypotheses at various confidence levels (5%, 1% and 0.1%) that are significant in the EELC model. Those significant hypotheses are highlighted in red colour and levels of significance (5% (*), 1% (**) and 0.1% (***)).

It reveals that two hypotheses (H_1 & H_2) out of six hypotheses (H_1 –H_5) were statistically significant to entrepreneurial leadership capacity at 0.1% confidence level (***). These are 1) entrepreneurial type and 2) market orientation. Among the next six (6) hypotheses (H_7 – H_{12}) in Figure 5.4, five hypotheses (H_7, H_8, H_9, H_{11} and H_{12}) were statistically significant to presence of opportunity, resource acquisition, decision for opportunity exploitation, process management and enhanced organisational achievement at 0.1% confidence level (***), while one hypothesis (H_{10}) was not statistically significant to resource acquisition at 5% confidence level (*). In the next five hypotheses (H_{13} – H_{17}) for entrepreneurial steps and enhanced organisational achievement, presence of opportunity was statistically significant to opportunity recognition (H_{13}) at 5% confidence level (*), while opportunity recognition was not statistically significant to decision for opportunity exploitation (H_{14}) at 5% confidence level (*). Decision for opportunity exploitation was statistically significant to resource acquisition at 5% confidence level (*). In addition, resource acquisition was statistically significant to process management (H_{16}) at 1% confidence level (**), while process management was statistically significant to enhanced organisational achievement (H_{17}) at 0.1% confidence level (***).

Finally**,** in Figure 3.4 in Chapter 3**,** next five (5) hypotheses (H_{18} - H_{22}**)** tested for the impact of the mediating role from entrepreneurial leadership capacity (ELC) between the independent variables (entrepreneurial type, market orientation, business climate, environmental uncertainty, competitive advantages and organisational strategy) and the dependent variable (presence of opportunity) in high-technology ventures. None of these five hypotheses was statistically significant to presence of opportunity, which was predicted by the author. The role of entrepreneurial leadership capacity as the mediator is critical to enhance the pursuit of modes of exploitation in the presence of opportunity.

In summary, from the result of this study, entrepreneurial type and market orientation are the two important factors/drivers affecting the entrepreneurial leadership capacity and the entrepreneurial process. The role of entrepreneurial leadership capacity as the mediator is confirmed to be critical to enhance the pursuit of modes of entrepreneurial exploitation in the presence of opportunity.

CHAPTER 6 CONCLUSION, LIMITATIONS AND FUTURE RESERACH

6.1 Chapter Introduction

This chapter aims to summarise the current study and offer suggestions for future research. The objective of the first section presents a summary of the findings of this study. This is followed by a discussion of the limitations involved in the research. Future research directions are also suggested. This chapter also discusses the contributions of this study to the body of knowledge relating not only to the deployment of entrepreneurial leadership capacity (ELC) in entrepreneurial, but also the overall knowledge in the fields of entrepreneurship, entrepreneurial leadership and practices in the high-technology ventures. Finally, it concludes with the chapter summary.

6.2 Summary of Findings

The current research on ELC was conducted based on the gap in the literature in identifying the factors affecting its successful deployment in high-technology entrepreneurship. This study developed a research model that used the environmental dynamism theory; entrepreneurial type theory; leadership capacity and entrepreneurial leadership frameworks and entrepreneurial process model. The constructs and variables of the research model, developed from the comprehensive literature review, were validated and enhanced by a quantitative study.

The purpose of this thesis has been to develop an EELC model for high technology ventures. It incorporates the mediating role of entrepreneurial leadership capacity which can enhance the pursuit of modes of exploitation in entrepreneurial process with enhanced organisational achievement (good business models and good enterprise performance). This new model will attempt to give new insights to link some the loose pieces of knowledge, frameworks or theories present in the “multidisciplinary jigsaw” of entrepreneurship. It is hoped that the outcome of this study will also try to make the discipline of entrepreneurship as a domain of “mature field” of discipline.

This new multidimensional integrative model has been developed from contemplation of the existing extensive literature which has led to the identification of a number of gaps in the explanatory power of extant models. After the new model was built and justified, it was applied to a study with high-technology industry such as the biotechnology industry, a science-based industry to simply validate its research findings. In the study, it was based on quantitative methods (Gray 2009; Kraska 2010).

Data obtained using a structured survey questionnaire with the sample size of 39 entrepreneurs from biotechnology companies can provide quantitative data required to test the validity of this new model shown in Figure 1.1. Although the sample size was not very big, this was a good response rate (33.2%) from the population of 121, due to a lot of very small biotechnology companies being included. From a lot of experience, numerous small biotechnology companies only had one or two persons which included the entrepreneur as well. It was extremely hard to get the permission to survey these entrepreneurs due to the immaturity or the early stage of industry life cycle for this particular industry.

In this research of new model of EELC, the independent variables are entrepreneurial type (PA, EI, SS and RM), market orientation, business climate, environmental uncertainty, competitive advantages and organisational strategy, while the dependent variables are presence of opportunity, opportunity recognition, decision for opportunity exploitation, resource acquisition, process management, business models and enterprise performance. Independent variable will act upon dependent variable only indirectly via the intervening variable, which is entrepreneurial leadership capacity, as the mediator.

In the development of this EELC model, 23 hypotheses (see Chapter 4 and 5) are structured to test the validity of this new model of entrepreneurship for high-technology ventures. Quantitative data could be generated which were required for the development of this new model of EELC.

Partial Least Squares (PLS) based Structural Equation Modeling (SEM) was applied to analyse the main survey data. The properties of the items and constructs, as well as the significance of the proposed relationships in the PLS model were examined. The results indicated that the item reliability, internal consistency and discriminant validity were relatively satisfactory in the comprehensive research model of EELC.

The results of the testing of hypotheses are detailed in Tables 5.27 and 5.28. The results of this study revealed that eleven (11) out of the twenty-one (21) hypotheses were accepted. Table 5.28 and Figure 5.4 list out the hypotheses at various confidence levels (5%, 1% and 0.1%) that are significant in the EELC model. Those significant hypotheses are highlighted in red colour and levels of significance (5% (*), 1% (**) and 0.1% (***)).

In this study, the PLS results show that the model exhibits explanatory power in the neighbourhood of 44% in the Entrepreneurial Leadership Capacity variable. It means that the model explained 44% of the variance in the Entrepreneurial Leadership Capacity variable, which is reasonably good (Holmes-Smith 2001). For the Enhanced Organisational Achievement variable, the model explained 39% of the variance. It is interesting to note that the percentage of variance explained of constructs, namely, Opportunity Recognition, Decision for Opportunity Exploitation, Process Management for Start-up variables were acceptable.

However, it is surprising to find that the percentage of variance in Presence of Opportunity variable was relatively low.

It reveals that two hypotheses (H_1 and H_2) out of six hypotheses (H_1 – H_5) were statistically significant to entrepreneurial leadership capacity at 0.1% confidence level (***). These are 1) entrepreneurial type and 2) market orientation. Among the next six (6) hypotheses (H_7 – H_{12}) in Figure 5.4, five hypotheses (H_7, H_8, $H_{9,}$ H_{11} and H_{12}) were statistically significant to presence of opportunity, resource acquisition, decision for opportunity exploitation, process management and enhanced organisational achievement at 0.1% confidence level (***), while one hypothesis (H_{10}) was not statistically significant to resource acquisition at 5% confidence level (*). In the next five hypotheses (H_{13} – H_{17}) for entrepreneurial steps and enhanced organisational achievement, presence of opportunity was statistically significant to opportunity recognition (H_{13}) at 5% confidence level (*), while opportunity recognition was not statistically significant to decision for opportunity exploitation (H_{14}) at 5% confidence level (*). Decision for opportunity exploitation was statistically significant to resource acquisition at 5% confidence level (*). In addition, resource acquisition was statistically significant to process management (H_{16}) at 1% confidence level (**), while process management was statistically significant to enhanced organisational achievement (H_{17}) at 0.1% confidence level (***).

Finally**,** in Figure 3.4 in Chapter 3**,** next five (5) hypotheses (H_{18} - H_{22}) tested for the impact of the mediating role from ELC between the independent variables (entrepreneurial type, market orientation, business climate, environmental uncertainty, competitive advantages and organisational strategy) and the dependent variable (presence of opportunity) in high-technology ventures. None of these five hypotheses was statistically significant to presence of opportunity, which was predicted by the author. The role of entrepreneurial leadership capacity as the mediator is critical to enhance the pursuit of modes of exploitation in the presence of opportunity.

In summary, from the result of this study, entrepreneurial type and market orientation are the two important factors/drivers affecting ELC and the entrepreneurial process. The role of ELC as the mediator is confirmed to be critical to enhance the pursuit of modes of exploitation in the presence of opportunity.

6.3 Limitations of the Research

However, there were some limitations involved in this study. The results of the current study should be interpreted cautiously due to these possible limitations. In regard to methodological issues, the sampling method might be of concern.

First, the selection of the participant companies and the samples was not purely random. As explained in the research methodology section, the companies taking part in the field study were selected based on convenience sampling. In the main survey, the approach of cross-sectional approach was utilised to select the biotechnology firms representing various segments of the Australian biotechnology industry. Although the contact persons were requested to randomly select the sample across departments and divisions, there could be some risk of sample bias.

Second, the four-way psychological typology (FWPT) applied to entrepreneurs identifies four entrepreneurial types: personal achiever (PA) entrepreneur, super sales people (SS) entrepreneur, expert idea generator (EI) entrepreneur and real manager (RM) entrepreneur. Due to the complexity and difficulty in handling the experimental condition of this study, no combinations of two, or more than two, entrepreneurial types present in an entrepreneur are considered in this thesis.

Third, the primary objective of this study is to build the new model of entrepreneurship incorporating entrepreneurial leadership capacity as the relationship mediator. Further tests or modification of the model can be applied later to suit the real situation of samples having combination of entrepreneurial types.

Fourth, attention has been paid to the concerns for homogeneity and randomness of samples in this study. The entrepreneur sample present in five states (New South Wales, Victoria, Queensland, Western Australia and South Australia) of the Australian biotechnology firms was assumed to be homogenous and random because some entrepreneurs were selected due to their availability during the research time.

Fifth, the study in this thesis is the outcome of the endeavours of a single researcher. No matter how strict the adoption of research design and principles, there is always a danger for personal bias which still remains a risk in this study. High quality of research protocol and good coding techniques can reduce the risks of personal bias in this aspect.

Sixth, although the sample size used in this study was appropriate for conducting the Partial Least Square Structural Equation Modelling (PLS-SEM), the results do not support generalisability of other high-technology industries.

Finally, the conclusions reached in the current study were not of universal application, since the research was conducted in the context of the biotechnology industry in Australia. This limited the generalisability of the findings of the current study to different geographical contexts and other industry sectors. The results of this research might be generalised through further examination and testing in other countries.

6.4 Future Research Directions

In this thesis, recommendation for the future research directions is listed in three areas: (1) relationship between the four-way psychological typology (Miner 2000) and the Big Five model of personality traits (Ciavarella et al. 2004); (2) the further financial analysis of financial charts and tables of the survey of Australian biotechnology firms shown in Appendices L to R and (3) further testing in other high-technology industry (e.g. IT) for advanced level of validity testing of this new model of entrepreneurship (EELC).

6.4.1 Linkage Between the Four-Way Psychological Typology and the Big Five Model of Personality Traits

In this study, the entrepreneurial types present in the Australian biotechnology industry were identified by using the four-way psychological typology (FWPT) (Miner 2000). However, the FWPT can only identify the entrepreneurial type. It cannot provide the detailed description of the entrepreneurial personality, which is the limitation of FWPT. In order to provide more information on the characteristics of this personality present in the entrepreneurial types (PA, SS, EI and RM) the mapping of the well-known Big Five factors model and the entrepreneurial types (FWPT) is the recommended future research direction as the next phase of development of this proposed model of entrepreneurship (EELC). The mapping can identify the linkages between the FWPT and the Big Five model of personality traits (Ciavarella et al. 2004). This can be one of the psychological assessments being employed by venture capital firms as a screening test for finding out the personality, or "character" of the founders-to-be of a company seeking venture capital investment (Miner 2000). Presently, such a screening test required by the venture capitalist is not fully developed in the financial market. This linkage will be beneficial to the venture capital market. This linkage can further develop the FWPT based on the widely accepted and extensively researched Big Five Model of Personality Traits. Since no research has been found in the literature to link Miner's (2000) psychological typology (FWPT) and the Big Five model of personality traits, this could present itself as further research for psychological typology in the study of entrepreneurship and performed together with the mapping of entrepreneurial personality traits.

The Big Five factors (extraversion, emotion stability or neuroticism, agreeableness, conscientiousness, and openness to experience), one of the most widely-accepted comprehensive models of personality, has been used to investigate the relationship between the entrepreneur's personality and the overall long-term survivability of a venture. From the findings of the study by Ciavarella et al. (2004), extraversion, emotional stability and agreeableness did not show relationships with long-term venture survival. Once an individual high in conscientiousness and/or low in openness to experience decides to become an entrepreneur, this person can commit to bring the venture from the start-up phase to venture survivability and then into venture maturity; and a longer venture life span. However, they also discovered "a negative relationship between openness and the entrepreneur's ability to lead the new venture to long-term survival". Another study, which has similar results to Ciavarella et al. (2004), demonstrated the relationship between Big Five personality and entrepreneurial status (Zhao & Seibert 2006). Results indicated that there were significant differences on personality dimensions between entrepreneurs and managers such as higher scores on conscientiousness and openness to experience, and lower scores on neuroticism or emotion stability and agreeableness. No difference was found with respect to extraversion.

Table 6.1 displays the linkage between the four-way psychological typology and the Big Five model of personality traits by mapping the similarities in these two frameworks. This is our proposed linkage mapping model. Further work needs to be done by conducting more extensive surveys of the bioentrepreneurs in the Australian biotechnology industry. These bioentrepreneurs will be asked about their characteristics in the format according to the Miner's four-way typology and the Big Five model of personality traits. Empirical results can be obtained in these future studies to verify the validity of this proposed linkage mapping model.

Based on Tables 2.4, 2.5 and 2.6, the common characteristics of both frameworks can be found by carefully studying the definition of each characteristic. The characteristics of psychological typology being studied are taken from Miner (2000) while the five factors are from Ciavarella et al. (2004). However, not each characteristic can be mapped as shown in the mapping matrix in Table 6.1. Further experiments and testing of Table 6.1 can be focused for future new entrepreneurship research.

The abbreviations for the Big Five factors are extraversion (Ex), stability/emotion stability (Es) or neuroticism, agreeableness (Ag), conscientiousness (Co), and openness to experience (Op) while PA, SS, EI and RM are used for "personal achiever", "super sales people", "expert idea generator" and "real manager" entrepreneurs. Table 6.1 can map the following linkage relationships: PA-ExEsCoOp; SS-ExAgCoOp; EI-ExEsOp and RM-ExEsCoOp. Where more than one overlapping of the five factors and the characteristics of each entrepreneurial typology occurred, it would be considered as one common characteristic for the linkage. If there is no overlapping for common characteristics, there is no abbreviated letter in the linkage relationship expression. There is no one entrepreneurial type possessing all five personality traits. The maximum number of mapping of the five factors in each linkage relationship is four.

Table 6.1 Mapping of the Big Five factors model and the entrepreneurial types

Entrepreneurial types	[1]Characteristic	[2]Big Five factors				
		Extraversion (surgency) (Ex)	Stability (neurotic-ism) (Es)	Agreeable-ness (likability, friendliness) (Ag)	Conscientious-ness (conformity, dependability) (Co)	Openness to experience (intellect) (Op)
Personal achievers (PA)	Motivation for self-achievement	√				
	Type A personality-achieve more in less time				√	
	Desire for feedback on achievement	√			√	√
	Desire to plan and set goals for future achievements	√			√	
	Strong personal commitment to their ventures		√		√	
	Desire to obtain information and learn					√
	Internal locus of control		√			
'Super' sales people (SS)	Capacity to understand and empathise others	√		√		
	Belief in the importance of social processes	√				√
	Desire to help others			√		
	Good at external relationship building	√			√	
	Belief in sales forces	√				
Expert idea generator (EI)	Desire to innovate personally					√
	Build venture around new products					√
	Involved with high-tech companies (conceptual in cognitive style)	√				
	Intelligence as source of competitive advantage					√
	Desire to avoid taking risks		√			
Real manager (RM)	Positive attitudes towards authority		√		√	
	Desire to compete with others	√			√	
	Desire to assert oneself	√				
	Desire to exercise power and to be corporate leader	√				
	Directive in cognitive style	√				√
	Desire to stand out from the crowd	√				
	Desire to perform managerial tasks	√			√	

Note: Not each characteristic can be mapped in the mapping matrix
Source: [1]Miner (2000) and [2]Ciavarella et al. (2004) or Tables 2.4, 2.5 and 2.6 in this thesis

All four types of bioentrepreneur have the personality trait of extraversion (Ex). Extraversion can also be used as a predictor of job performance for managerial and sales people (Barrick & Mount 1991). This result is very similar to the research results of Judge et al. (1999), who demonstrated that extraverted people are more likely to have leadership roles. Nicholson (1998) determined that entrepreneurial leaders are more stress-resistant (a trait of Es), assertive (Ex) and conscientious (Co) as compared to other managers. This is very similar to the linkage relationships for “personal achiever” and “real manager” entrepreneurs, PA-ExEsCoOp and RM-ExEsCoOp without the trait of Op. Based on the findings from Nicholson (1998) and the linkage mapping, “personal achiever” and “real manager” entrepreneurs can be considered as the entrepreneurial leaders in the setting of a company. PA entrepreneur does not have the personality trait of agreeableness (Ag) but has more mappings on conscientiousness (Co) and extraversion (Ex). SS entrepreneur does not have any mappings on Es trait but on Ex, Ag, Co and Op. Ciavarella et al. (2004) suggest that individuals with no, or low stability (Es) are prone to stress and to have sustained periods of irritability, and anxiety. Unstable characters such as emotional volatility and worrying are the most common obstacles for entrepreneurs who are low in stability (Es). SS biontrepreneurs who demonstrate these attitudes and behaviours in their biotech businesses will not succeed over the long-term, and will exit from the new venture ownership very quickly.

EI entrepreneur only has the mappings of Ex, Es and Op. In addition, RM entrepreneur does not have any mappings on Ag but only have the Ex, Es, Co and Op. Entrepreneurs who are high in Ag tend to be courteous, cooperative, forgiving and flexible in dealing with customers and reap the profits of repeat business. According to Cable and Shane (1997, p. 145), they propose that “cooperation is a key factor in the entrepreneur’s ability to secure capital and future support from venture capitalists, increasing the chance for long-term survival of the venture”. Only SS entrepreneurs have the Ag personality mapped in Table 6.1. This is a very important point for bioentrepreneurs because there is a shortage of “super sales people” bioentrepreneurs in the biotechnology sector as shown in Figure 5.8. That may explain why the biotechnology sector can attract so much less venture capital investment due to the less cooperative behaviour of the dominate presence of PA and EI bioentrepreneurs. However, Ag was not found to be a predictor of job performance for managers or sales people (Hurtz & Donovan 2000; Barrick & Mount 1991). Baron and Markman (2000, p. 110) explain further regarding Ag factor as the interpersonal relations rather than task performance:

> “That entrepreneurs who are trusting and cooperative in their business relationships are more likely to develop alliances with larger companies, resulting in new product development, shareholder wealth, and venture survival.”

Since there are more “personal achiever” and “expert idea generator” entrepreneurs with the linkage relationships of PA-ExEsCoOp and EI-ExEsOp (Table 6.1), there are strong demands for the entrepreneurs having managerial skills, sales and marketing skills, skills in forming strategic alliance with partners and skills in securing the public and private capitals through finance channels such as public listing and venture capital (Yim & Weston 2006). This implies that if PA entrepreneurs acquired more agreeableness personality traits and EI entrepreneurs also acquired more agreeableness and conscientiousness personality traits they would improve the ability of their businesses to attract more financial investments and form sustainable strategic alliance with partners in the Australian biotechnology industry.

Entrepreneurs who have high conscientiousness (Co) tend to be industrious, efficient, dependable, hardworking, achievement-oriented, and preserving. Co is found to be a consistent predictor of job performance across occupations involving managing others and sales performance (Barrick & Mount 1991). This kind of entrepreneur can lead the new venture to long-term survival. In addition, the very first criterion that venture capitalists will look for in prospective loan recipients is the ability of sustained intense effort (i.e. persevering from the conscientiousness) (MacMillan, Siegel & Narasimha 1985).

Entrepreneurs who are high in openness (Op) are considered as being intellectual, intelligent, and open to new ideas and experience. Despite this finding, this factor has had little relationship with organisational outcomes and its direct relationship with cognitive ability has contribution to workplace environments (Barrick & Mount 1991). Entrepreneurs having this openness attribute do not lead to the long-term venture survival.

From the findings of the study by Ciavarella et al. (2004), extraversion (Ex), stability (Es) and agreeableness (Ag) did not show relationships to long-term venture survival. Once an individual who is high in conscientiousness (Co) and/or low in openness (Op) to experience, decides to become an entrepreneur, this person can commit to bring the venture from the start-up phase to venture survivability and then into venture maturity; and a longer venture life span. However, they also discovered that a negative relationship between openness and the entrepreneur's ability to lead the new venture to long-term survival. Future research should explore the implications of the differences between these two groups in their openness to new experience" (Ciavarella et al. 2004).

6.4.2 Financial Analysis of the Surveyed Biotechnology Firms

Financial information including share prices, annual financial summary and price-sensitive measures for the surveyed Australian listed biotechnology firms, have been compiled and displayed in Appendices O to U. This information provides a very good background regarding their enterprise performance, which is predicted in the new model of entrepreneurship (EELC) for these surveyed Australian biotechnology firms. Since the financial analysis is not the main focus in this thesis, I would recommend further financial analysis of these charts and tables as the future research direction for advanced level of testing the validity of this new model of EELC.

6.4.3 Further testing of EELC model in other high-technology industry

This EELC model can be further tested in other high-technology industry, for example, information technology (IT). The IT industry also plays a critical role in the development of the national economy.

Information Technology, or IT, also called Information Service (IS) or Management Information Service (MIS), is defined as the development, design, study, implementation and management of computer-related information. It can also be defined as the use of computer hardware and software to manage information.

The importance of entrepreneurship to the success of IT industry has been extensively documented (Janson & Wrycza 1999; Why is information technology important? 2012).

IT firms need to continually invest in technology to remain competitive (Wernerfelt 1984). Entrepreneurship can help the IT industry to pursue and explore opportunites. Allocation of resources as part of entrepreneurship has to be determined properly. Technology resources are crucial for firms to create wealth, by enabling firms to create value for customers (Sirmon, Hitt & Ireland 2007) and to develop competitive advantages (Grant 1991). As a result, determining how much to allocate for technology investment is one of the key decisions of the entrepreneur in a high-technology venture. Technology investment can take various forms, including expenditures on new buildings, equipment, or research and development. The expectation is that this type of technology investment will lead to greater performance among high-technology firms in developed and emerging economies (Siqueira & Bruton 2010).

6.5 Contributions of the Research

The four (4) contributions of this research are as follows: (1) an EELC model that identifies type of personality by would-be founders and conducive to making investment decisions by venture capitalists; (2) the identification of key factors determining entrepreneurial success in the Australian biotechnology industry; (3) the further development of Vecchio's (2003) entrepreneurial leadership theory; and (4) the extension of knowledge for new research direction and theory building of entrepreneurship as a "mature field" of discipline by incorporating entrepreneurial leadership capacity as the mediator. More detailed discussion for each contribution will be explained below.

(1) Contribution to screening process by venture capitalists

It is critical that venture capitalists make the right decision in investing in the right entrepreneurs for potential business opportunities. The four-way psychological typology (FWPT) which is one of the psychological assessments is often employed by venture capital firms as a screen test to find out the personality, or "character" of the founders-to-be of a company that is seeking venture capital investment (Miner

2000). The new model suggests that this type of personality test should still be seen as a good tool and sound investment by the venture capitalist to include it in the screening process of the would-be founders in the decision to go ahead with their investment or not. Entrepreneurial types from the FWPT (personal achiever (PA), expert idea generator (EI), super sales people (SS) and real manager (RM)) combined with the availability of information and of entrepreneurial leadership skills will have the chance to exploit entrepreneurial opportunities for high-technology industry like biotechnology venture growth through their entrepreneurial success routes (*achieving route, idea generating route*, *selling route and managing route*) (Miner 2000). From the findings, this research makes a contribution to solve the missing information issue of entrepreneur's type of personality required by the screening process of venture capitalists for the would-be founders in granting investment decisions in biotechnology ventures.

(2) Contribution to identification of key factors for entrepreneurial success in biotechnology industry

The new model EELC identifies the key factors for entrepreneurial success in high-technology industry such as the biotechnology industry, and I seek to confirm this by the sample survey of the Australian biotechnology industry. This thesis provides an analysis of how these key factors or drivers match the requirements of those providing venture capital to the industry. The outcomes of this research include the identification of key success factors or drivers that distinguish the small number of successful ventures from those that languish at small capitalisation values. This output should result in an improvement in the allocation of funds to the industry and its various sectors. In general, it should minimise the wastage of funds that is presently a feature of the biotechnology industry.

The empirical evidence used in this study primarily relied on surveys of company executives/entrepreneurs. The contribution of this new model is to the knowledge of finding the key success factors or drivers present in high-technology ventures. Each element present in the new model EELC can be important to the entrepreneurial success of biotechnology ventures. It proves to be vital that the proposed new model of entrepreneurship will have long-term value to the running of successful Australian biotechnology companies and meeting the funding requirements of venture capitalists.

(3) Contribution to development of entrepreneurial leadership theories

The EELC model this thesis has developed makes a significant contribution to the further development of entrepreneurial leadership theories on its own, as stated by Vecchio (2003) in Figure 2.8 (Chapter 2). This new model of entrepreneurship further contributes to the theory building of entrepreneurial leadership by expanding Vecchio's (2003) model in providing a better understanding of the relationship among entrepreneurial types in the four-way psychological typology (FWPT), the mediating role of entrepreneurial leadership capacity (ELC), entrepreneurial opportunity exploitation, business models and enterprise performance in high-technology ventures like biotechnology industry.

These findings further contribute to the knowledge of the mutual significance of entrepreneurial personality or traits and leadership in good business concept by having appropriate business models and good enterprise performance in biotechnology venture growth. The addition of the four-way psychological typology (FWPT) to Vecchio's (2003) model of entrepreneurial leadership further enriches its usefulness and provides accuracy to the prediction of identifying the would-be founders in the investment decision.

The author has defined this new term, entrepreneurial leadership capacity (ELC) at Chapter 3.5.

<u>(4) Contribution to development of entrepreneurship theories as a mature field of discipline</u>

This research makes a contribution to the extension of knowledge for new research direction and theory building of entrepreneurship as a “mature field” of discipline by incorporating entrepreneurial leadership capacity as the mediator. In the past, entrepreneurship researchers have ignored the option of separating the study of entrepreneurship and leadership into two disciplines; this may have caused the high occurrence of failure in venture growth due to the lack of effective leadership behaviour in entrepreneurs (Gupta et al. 2004). The new EELC model may offer to link some of the loose pieces of knowledge, frameworks or theories together in this “multidisciplinary jigsaw” of entrepreneurship. This new EELC model for high-technology ventures will significantly contribute to the literature on which to base new directions for entrepreneurship research. This new research direction opens up a new horizon by borrowing the successful lessons that leadership discipline has journeyed through before, and integrating these into building entrepreneurship as a “mature field” of discipline with less growing pains. The addition of entrepreneurial leadership capacity into the theory building of entrepreneurship enables some gaps in the existing theory to be filled, which further enriches and leads such “immature field” of entrepreneurship to maturity.

6.6 Chapter Summary

This new model will attempt to give new insights to link some the loose pieces of knowledge, frameworks or theories present in the “multidisciplinary jigsaw” of entrepreneurship. It is hoped that the outcome of this study will also establish the discipline of entrepreneurship as a domain of “mature field” of discipline.

In this research of new model of EELC, the independent variables are entrepreneurial type (PA, EI, SS and RM), market orientation, business climate, environmental uncertainty, competitive advantages and organisational strategy, while the dependent variables are presence of opportunity, opportunity recognition, decision for opportunity exploitation, resource acquisition, process management, business models and enterprise performance. Independent variables will act on dependent variables only indirectly via an intervening variable as the mediator; this is entrepreneurial leadership capacity.

In this study, the PLS results show that the model exhibits explanatory power in the neighbourhood of 44% in the Entrepreneurial Leadership Capacity variable. It means that the model explained 44% of the variance in the Entrepreneurial Leadership Capacity variable, which is reasonably good (Holmes-Smith 2001).

Two future research directions can be noted**:** financial analysis of the charts and tables in Appendices O to U, and the identification of the linkage between the four-way psychological typology and the Big Five model of personality traits.

This EELC model can also be applied in other high-technology industry, for example, information technology (IT).

In summary, from the result of this study, entrepreneurial type and market orientation are the two important factors/drivers affecting the entrepreneurial leadership capacity (ELC) and the entrepreneurial process. The role of ELC as the mediator is confirmed to be critical to enhance the pursuit of modes of entrepreneurial exploitation in the presence of opportunity.

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APPENDICES

APPENDIX A1: Ethics approval letter for conducting the survey

Appendix A1 removed from Open Access version as it may contain sensitive/ confidential content.

APPENDIX A2: Covering letter for survey

Mr ABC
CEO 1st December 2005
XYD Ltd
Level 2, 47 Bligh Street
Sydney, NSW 2000

<u>Survey for understanding the entrepreneurial process in Australian biotechnology companies</u>

The Australian biotechnology industry has been booming rapidly and has contributed significantly to the overall growth of the entire industry sectors. Your company is an important player in the biotechnology industry and its success is very critical to the achievements of the industry.

This study focuses on the identification of key factors determining entrepreneurial success in the main sectors of the Australian biotechnology industry, together with an analysis of how these factors match the requirements of those providing venture capital to the industry. The expected outcomes of this research include the identification of key success factors that distinguish the small number of successful ventures from those that languish at small capitalisation values. The outcomes of this project should result in an improvement in the allocation of funds to the industry and its various sectors and should help to minimise the waste of funds that is presently a feature of the industry.

I am writing to you to invite managers in your company to participate in a survey that should take one hour to complete. The purpose of the survey is to understand the entrepreneurial process in your company. An appointment will be arranged with your company to conduct a one-hour interview. The results from this survey will provide the basis for a doctoral thesis in which an integrated framework for the bioentrepreneurship in Australian biotechnology industry will be proposed. A copy of the summary of the survey results can be sent to you on request.

Your participation in this survey is very important to the building of the integrated framework, which could provide valuable knowledge for the biotechnology industry. Your opinion and experience is unique and vital for this research. Enclosed in this letter is the questionnaire that I will be using in the interview. Your responses in the interview will be treated in **strict confidence** and will not be released except in an anonymous collated form.

Should you wish to verify the authenticity of this interview, you can call Professor Rae Weston, Macquarie Graduate School of Management (MGSM), Macquarie University on . If you need help in understanding this questionnaire, please contact Julian Wai-Wa Yim on or via email to

Thank you very much for your time and your involvement in this survey.

Yours sincerely

Julian Wai-Wa Yim
Doctoral Candidate
Macquarie Graduate School of Management
Macquarie University
Sydney NSW 2109
Phone: (Mobile)
Email address:

APPENDIX B: Consent form for survey participant

Information and Consent Form

Name of Project: A New Model of Entrepreneurship with Entrepreneurial Leadership Capacity (EELC) for High Technology: A Biotechnology Industry Application

You are invited to participate in a study of bioentrepreneurship in the Australian biotechnology industry. The purpose of the study is to identify the key factors determining entrepreneurial success in the main sectors of the Australian biotechnology industry, together with an analysis of how these factors match the requirements of those providing venture capital to the industry. The results of this project will help us better understand the key success factors that distinguish the small number of successful ventures from those that languish at small capitalisation values. The outcomes of this project should result in an improvement in the allocation of funds to the industry and its various sectors and should help to minimise the waste of funds that is presently a feature of the industry.

.

The study is being conducted by Julian Wai-Wa Yim of Macquarie Graduate School of Management, Macquarie University (Mobile phone :).

If you decide to participate, you will be asked to complete the questionnaire during the interview with the investigator. No additional questions will be asked during the interview.

Any information or personal details gathered in the course of the study are confidential. No individual will be identified in any publication of the results. Only the investigator and the supervisor will have access to the data.

If you decide to participate, you are free to withdraw from further participation in the research at any time without having to give a reason and without consequence.

I, *(participant's name)* have read *(or, where appropriate, have had read to me)* and understand the information above and any questions I have asked have been answered to my satisfaction. I agree to participate in this research, knowing that I can withdraw from further participation in the research at any time without consequence. I have been given a copy of this form to keep.

Participant's Name:
(block letters)

Participant's Signature: Date:

Investigator's Name:
(block letters)

Investigator's Signature: Date:

The ethical aspects of this study have been approved by the Macquarie University Ethics Review Committee (Human Research). If you have any complaints or reservations about any ethical aspect of your participation in this research, you may contact the Ethics Review Committee through its Secretary (telephone 9850 7854; email ethics@mq.edu.au). Any complaint you make will be treated in confidence and investigated, and you will be informed of the outcome.

(INVESTIGATOR'S [OR PARTICIPANT'S] COPY)

APPENDIX C: Survey questionnaire

Strictly Confidential

Questionnaire

Survey of the entrepreneurship in Australian biotechnology industry

Julian Wai-Wa Yim

Macquarie Graduate School of Management (MGSM)

Macquarie University

November 2005

Survey of the entrepreneurship in Australian biotechnology industry

INSTRUCTIONS Company Code: ____

You are required to read each question carefully and follow the instructions in each question. Answer all the questions in the space provided. If you are not sure to provide the response, you have to give the best estimation to each question instead of leaving no answer at all.

To enhance the filling of the questionnaire, you may find it useful to have on hand your company's past three years financial statements or report in order to answer some questions in this questionnaire. Your responses will be treated in **strict confidence**. Results from this survey will provide the basis for a doctoral thesis in which it can propose an integrated framework for the bioentrepreneurship in Australian biotechnology industry. This is very valuable knowledge for the biotechnology industry.

Thank you very much for your time and your involvement in this survey.

Name of person filling the survey (optional): ________________ Date: ______

Company Position: _________________________

SECTION 1: COMPANY INFORMATION

Please fill in the information for your company.

Q1	Name of company	
Q2	Address	 State : Postcode:
Q3	Date of company establishment	
Q4	Age of company by end of 2005	
Q5	Country origin of company	
Q6	Nature of company [Tick (√) only one choice]	a) Publicly listed company [ ] b) Privately-owned company [ ] c) Government-owned [ ] d) Joint venture [ ] e) University-owned [ ] f) Other ______________________ [ ]
Q7	Origin of company [Tick (√) only one choice]	a) University spin-off [ ] Name of university:_______ b) Government research institute/department spin-off [ ] c) Industrial spin-off [ ] d) Corporate branch [ ] e) Independent venture [ ] f) Private investor + university collaboration [ ] g) Other _______________________ [ ]
Q8	Company ownership [Tick (√) only one choice]	a) Australian-owned [ ] b) Foreign-owned [ ] c) Combination of Aust. and foreign owned [ ] d) Other _______________________ [ ]

Q9	Firm size by employment in 2005 [Tick (√) only one choice]	a) 1-50 employees [ ] b) 51-150 employees [ ] c) Over 150 or more employees [ ]
Q10	Distribution of employment by function in 2005 [Fill in % for each function]	a) Research & Development _______% b) Finance _______% c) Manufacturing _______% d) Marketing, sales _______% e) General management _______%
Q11	Distribution of revenues in 2005 (geographic sources)	a) Within capital city (eg Sydney) ______% b) Within the same state (eg NSW) ______% c) Elsewhere in Australia ______% d) Outside Australia ______% e) Other _______________
Q12	Total revenue in 2005 [Tick (√) only one choice]	a) Less than A$ 5 million [ ] b) A$6-20 million [ ] c) A$21-50 million [ ] d) A$51-100 million [ ] e) A$101-200 million [ ] f) Over A$200 million [ ] g) Zero revenue [ ] h) Other _______________ [ ]
Q13	Distribution of revenue by sources in 2005 [Fill in % for each source]	a) Product sales [ ] ______% b) Royalty/licensing [ ] ______% c) Contract/collaboration [ ] ______% d) Interest revenue [ ] ______% e) Agreement with big firm [ ] ______% f) Government grants/loans [ ] ______% g) R&D [ ] ______% h) Shareholders [ ] ______% i) Other _________________ [ ] ______%
Q14	Number of locations in 2005 [Tick (√) only one choice]	a) Single establishment [ ] b) Multiple locations [ ]
Q15	Overseas export activity [Can tick (√) more than one choice]	a) Regular exporter [ ] b) Periodic exporter [ ] c) Non-exporter [ ] d) Future exporter [ ] e) Other ___________________________ [ ]
Q16	Type of technology sector in your company [Can tick (√) more than one choice]	a) Human therapeutics [ ] b) Agricultural biotech [ ] c) Medical diagnostics [ ] d) Suppliers [ ] e) Chemical, environment etc [ ] f) Bioinformatics [ ] g) Medical devices [ ] h) Animal health [ ] i) Research tools/diagnostics [ ] j) Other ___________________ [ ]
Q17	The percentage (%) of total expenditure spent on Research & Development expense in 2005 (R&D intensity)	________________%
Q18	The percentage (%) of total expenditure spent on marketing/ distribution expense in 2005	________________%
Q19	The percentage (%) of sales from new products in 2005	________________%
Q20	Estimated time to revenue	a) 1-2 years [ ] b) 3-5 years [ ]

		c) 5-10 years [ ] d) 10-15 years [ ] e) Over 15 years [ ] f) Now [ ]
Q21	Major technology expertise for your company [Can tick (√) more than one choice]	a) Genomics [ ] b) Lead compound identification/ screening/targets [ ] c) Diagnostics [ ] d) Services [ ] e) Delivery mechanisms [ ] f) Bioinformatics [ ] g) Biomaterials/bioactives [ ] h) Platform technologies [ ] i) Tissue engineering [ ] j) Proteomics [ ] k) Libraries/databases [ ] l) Medical devices [ ] m) DNA therapy [ ] n) Therapeutic antibody [ ] o) Cell therapy [ ] p) Diagnostic antibody [ ] q) Gene therapy [ ] r) Bioprospecting [ ] s) Nanotechnology [ ] t) Drug delivery/pharmaceutical processing [ ] u) Enzymes & expression [ ] v) Probiotics [ ] w) Oncology/therapeutic virus [ ] x) Product development [ ] y) Vaccines/pepties [ ] z) Drug development [ ]
Q22	Reasons for company formation [Can tick (√) more than one choice]	a) Simply commercial potential and benefit [ ] b) Corporate branch [ ] c) Aim for building a large life science company [ ] d) Tax/legal liability/regulatory reasons [ ] e) Future commercialisation potential [ ] f) Reward/remuneration for staff [ ] g) Make money [ ] h) Other __________________________ [ ]

SECTION 2: RESEARCH MODEL

PART A: ENTREPRENEURIAL PROCESS FOR VENTURE GROWTH (Q23)

Q23 Please rank the level of importance by ticking (√) inside the box for each characteristic for the impact to each entrepreneurial process step in biotechnology industry.

Factor: Entrepreneurial process	Characteristics	Not important	Less important	Important	Very important	Extremely important
Resource acquisition: [Tick (√) each characteristic]	Skilled employees					
	General management expertise					
	Marketing and sales expertise					
	Technical expertise					
	Financing					
	Distribution					
	Source of supply					
	Production facilities					
	Licences, patents and legal protection					
Presence of opportunity: [Tick (√) each characteristic]	In market (eg needs, customers and potential market size)					
	In Economy (eg profits after tax and time to break even etc)					
	In competitive advantage (eg barrier to entry, and degree of control over costs and prices etc)					
	In network/management expertise/risk control					
Process management: [Tick (√) each characteristic]	Absorption of new concept into mainstream operations					
	Licensing of rights with other company					
	Calculating the uncertainty of opportunities/risk					
	Company organisation design					
Decision for opportunity exploitation (From the list which is the key one your company is doing?) [Tick (√) each characteristic]	New products					
	New services					
	New processes					
	New markets					
	New organisational structure/forms					
	New technologies					
	New sales or distribution channels					
Opportunity recognition: [Tick (√) each characteristic]	Changing demographics					
	Emergence of new market segments					
	New process needs					
	New technologies					
	Incongruities/ Lack of harmony					
	Regulatory change					
	Social change					

PART B: ENTREPRENEUR (Q24-Q30)

Q24 Please rank the level of importance by ticking (√) inside the box for each type of entrepreneur for the impact to each entrepreneurial framework in biotechnology.

Factor: Entrepreneur	**Type of Entrepreneur**	**Not important**	**Less important**	**Important**	**Very important**	**Extremely important**
Entrepreneurial types [Tick (√) each type]	a) Personal achievers (e.g. strong commitment and internal locus control)					
	b) 'Super' sales people (e.g. belief in sales force, good at external relationship building)					
	c) Expert idea generators (e.g. building venture around new products and desire for innovation)					
	d) Real manager (e.g. desire for taking charge and to be corporate leader)					

Q25	Who are the entrepreneurs in your company? [You can tick (√) more than one type]	a) Inventor/founder [ ] b) Chairman of board [ ] c) CEO [ ] d) Administrative director/ manager [ ] e) Scientific/technical director [ ] f) Business dev. Manager [ ] g) Major shareholder [ ] h) Other ______________________ [ ]
Q26	What type of entrepreneurs does your company have? [You can tick (√) more than one type]	a) Personal achievers [ ] b) 'Super' sales people [ ] c) Expert idea generators [ ] d) Real manager [ ]
Q27	Which entrepreneurial type do you think is the most appropriate type for biotechnology industry? Please rank the type of entrepreneur (1, 2, 3 etc) inside the bracket ([ ]) that you think is appropriate for biotechnology industry. For example: 1 is the most appropriate type and 4 is the most inappropriate type	a) Personal achievers [ ] b) 'Super' sales people [ ] c) Expert idea generators [ ] d) Real manager [ ] Comment: ____________________________ ______________________________________ ______________________________________ ______________________________________ ______________________________________ ______________________________________

PART C: ENTREPRENEURIAL LEADERSHIP CAPACITY (ELC) (Q28-Q34)

TYPES OF INNOVATION, RECOGNITION OF INNOVATION BARRIERS AND R&D/INNOVATION/CREATIVITY/KNOWLEDGE MANAGEMENT (Q28-Q34)

Q28 Please rank the level of importance to your company by ticking (√) inside \ the box for each type of innovation that is applicable to your company.

Factor: ELC	**Innovation types**	**Not important**	**Less important**	**Important**	**Very important**	**Extremely important**
Tick (√) each type	New to the world product or service					
	New to the firm product or service in line that at least one competitor is offering					
	New to the country and/or market product or service					
	New application of existing product or service, including application to a new market segment					
	Addition to a company's existing product or service line					
	Repositioning of an existing product or service					
	Product/service improvement, revision, including application of new feature or option or change					
	Process improvement that leads to customer value creation, productivity enhancement, and/or cost reduction: a) new administrative system or procedure					
	b) new production method					
	c) new marketing or sales approach					
	d) new customer support program					
	e) new logistical approach					
	f) new pricing approach					
	g) new distribution channel or method					
	h) new financing method					
	i) new purchasing technique					
	j) new organisational form or structure					

		Innovation types	**Time for market launch**
Q29	What are the major innovation types that your company are developing? When is the proposed time for market launch for each innovation type? **Please suggest the innovation types and also list the time for market launch.**	a) ________________ ________________ b) ________________ ________________ c) ________________ ________________ d) ________________ ________________ e) ________________ ________________ f) ________________ ________________	a) ________________ ________________ b) ________________ ________________ c) ________________ ________________ d) ________________ ________________ e) ________________ ________________ f) ________________ ________________

		No. of cases in past five years
Q30	What will be the number of cases your company has for the following innovations? (innovation measures)	a) Australia patent applications filed ______ b) International patent applications filed ______ c) Australia patent approvals received ______ d) International patent pending/approvals by other country received _______ e) New products introduced ______ f) New processes introduced ______ g) Redesigned products _______ h) Redesigned processes _______

Q31 Please rank the level of barrier by ticking (√) inside the box for each type of barrier for the impact to each entrepreneurial framework in biotechnology industry.

Factor: ELC	**Recognition of innovation barriers**	**No barrier**	**Less barrier**	**Barrier**	**Medium barrier**	**Major barrier**
Tick (√) each type	Financial					
	Lack of venture capital in early stage of venture					
	Lack of public funds in early stage of venture					
	Lack of government research funds in early stage of venture					
	Lack of venture capital in late stage of venture					
	Lack of public funds in late stage of venture					
	Lack of government research funds in late stage of venture					
	Other:					
	Regulatory					
	Australian government regulations (eg state or federal)					
	Foreign government regulations (eg CE/EMEA approval etc)					
	Australian patent process					
	Foreign patent process					
	TGA approval process					
	FDA approval process					
	Other:					
	Resource					
	Lack of skilled managers					
	Lack of skilled researchers					
	Lack of research facilities/assets					
	Lack of manufacturing facilities					
	Lack of marketing/distribution channels					
	Lack of clinical trial facilities					
	Other:					

		Types of deals	Name of company for the deal/ No. of deals
Q32	Does your company have any of the following deals in the operation? If yes, please state the name of the company for the deal/number of deals. [You can tick (√) more than one choice]	a) Licensing [ ] b) Joint venture [ ] c) Alliance [ ] d) Merger [ ] e) Acquisition [ ] f) Investment [ ] g) Other _____________ [ ]	a) ________________________ b) ________________________ c) ________________________ d) ________________________ e) ________________________ f) ________________________ g) ________________________

		IP protection	No. of cases/families in 2005
Q33	What intellectual property protection does your company have in knowledge management? [You can tick (√) more than one choice]	a) Patents only [ ] b) Trade marks only [ ] c) Patents + trade marks [ ] d) Copyright [ ] e) Design registration [ ] f) Trade secrets only [ ] g) Patents + trade secrets [ ] h) None [ ]	a)________________________ b)________________________ c)________________________ d)________________________ e)________________________ f)________________________ g) ________________________ h) ________________________

		IP protection
Q34	In your own opinion, how would you rate the overall IP position of your company in knowledge management? [Tick (√) only one choice]	a) Extremely robust [ ] b) Strong [ ] c) Fairly strong [ ] d) Arguable [ ] e) Weak [ ]

PART D: ENHANCED ORGANISATIONAL ACHIEVEMENT (Q35-Q37)

Q35	Does your company have any products for sale currently? [Tick (√) only one choice]	a) Yes [ ] b) No [ ]

Q36 Please rank the level of importance by ticking (√) inside the box for each characteristic for the impact to business model in biotechnology industry.

	Characteristics	**Not important**	**Less important**	**Important**	**Very important**	**Extremely important**
Q36 Business model: [Tick (√) each characteristic]	Strategic alliance with partners					
	Refocussed current product development					
	Launch new products					
	Raised public capital					
	Raised private capital					
	Acquisition					
	Merger					

Q37 Please rank the level of importance by ticking (√) inside the box for each characteristic for the impact to enterprise performance in biotechnology industry.

	Characteristics	Not important	Less important	Important	Very important	Extremely important
Q 37 Enterprise performance: [Tick (√) each characteristic]	Managerial skills					
	Efficiency/speed of product development					
	Skilled labour					
	Quality of product					
	Marketing capability					
	Collaboration with universities/research centres					
	Government support					
	Collaboration with industrial companies					
	Access to seed/venture capital					
	Collaboration with other biotechnology companies					
	Access to domestic markets					
	Physical proximity to collaborators					
	Access to international markets					
	Ability to recognise commercial application of technology					
	Learning from end users					
	Technology transfer from suppliers/ inventors					
	Research capability					

PART E: EXTERNAL AND ORGANISATIONAL DRIVERS (Q38-Q42)

Please rank the level of importance by ticking (√) inside the box for each driver for the impact to biotechnology industry.

Factor: External drivers	**Issues**	**Not important**	**Less important**	**Important**	**Very important**	**Extremely important**
Q38 Market orientation [Tick (√) each issue]	a) Identified customer needs					
	b) Emerging industry					
	c) High market growth rate (eg 30-50%)					
	d) High gross margin (eg 40-50%)					
	e) Reasonable market share (eg 20%)					
Q39 Business climate [Tick (√) each issue]	a) Good profit after tax (eg 10-15%)					
	b) Short time to break even and positive cash flow (eg under 2 years)					
	c) Low to moderate capital requirements					
Q40 Competitive advantages [Tick (√) each issue]	a) Low fixed and variable costs for production/marketing/distribution					
	b) Moderate to strong degree of control for prices/costs/channels of supply etc					
	c) Barriers to entry for proprietary protection/lead time/legal advantage					
	d) Product differentiation					
Q41 Environmental uncertainty [Tick (√) each issue]	a) Political infrastructure in society					
	b) Legal infrastructure					
	c) Regulatory infrastructure					
	e) Financial infrastructure					
	f) Socio-cultural infrastructure					

Factor: Organisational drivers	**Issues**	**Not important**	**Less important**	**Important**	**Very important**	**Extremely important**
Q42 Organisational strategy [Tick (√) each issue]	a) Logistical infrastructure					
	b) Within-company infrastructure					
	c) Networks/contacts					
	d) Management team expertise					
	e) Risk control					

SECTION 3: MISCELLANEOUS

Q43 What are the challenges that Australian biotechnology industry is facing now?

____

Q44 Would like to receive a copy of the survey summary? [ ] Yes [ ] No

Q45 Comments on the questionnaire

a) On any of the information you have supplied in this questionnaire
b) On any questions which have caused problems
c) If you would like to suggest improvements to this questionnaire

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Thank you for your participation in this survey
Please return the completed survey to:
Julian Wai-Wa Yim
Macquarie Graduate School of Management, Macquarie University
NSW 2109

APPENDIX D: Scale reliability and descriptive statistics for construct measures

Scale	Construct measure	Question number	Assigned reference code	Alpha Coefficient	Mean	Standard deviation
Entrepreneur (EN)	**Entrepreneurial types (ET)**	24				
	- Personal achiever		ETPA	0.901	4.1538	0.7793
	- Super' sales people		ETSS	0.902	3.6154	1.0161
	- Expert idea generator		ETEI	0.900	3.7436	1.0442
	- Real manager		ETRM	0.900	3.6667	1.0345
External driver (ED)	**Market orientation (MO)**	38				
	- Identified customer needs		MOIC	0.902	4.3077	0.8931
	- Emerging industry		MOEI	0.901	3.1538	0.9608
	- High market growth rate (eg 30-50%)		MOMR	0.901	3.3846	0.8465
	- High gross margin (eg 40-50%)		MOGM	0.902	3.7692	0.8417
	- Reasonable market share (eg 20%)		MOMS	0.900	3.1538	0.7793
	Business climate (BC)	39				
	- Good profit after tax (eg 10-15%)		BCPT	0.902	3.8205	0.8231
	- Short time to break even and positive cash flow (eg under 2 years)		BCBE	0.902	3.1282	1.1738
	- Low to moderate capital requirements		BCCR	0.901	3.0769	0.8074
	Competitive advantages (CA)	40				
	- Low fixed and variable costs for production/marketing/distribution		CAFC	0.902	3.1538	0.9878
	- Moderate to strong degree of control for prices/costs/channels of supply etc		CACP	0.901	3.1795	0.8231
	- Barriers to entry for proprietary protection/lead time/legal advantage		CABE	0.902	4.4615	0.7896
	- Product differentiation		CAPD	0.900	4.3077	0.9221
	Environmental uncertainty (EU)	41				
	- Political infrastructure in society		EUPI	0.900	2.4359	0.9678
	- Legal infrastructure		EULI	0.900	2.5128	0.9140
	- Regulatory infrastructure		EURI	0.900	3.7179	0.9987
	- Socio-cultural infrastructure		EUSI	0.901	2.3846	0.8771
	- Financial infrastructure		EUFI	0.901	3.7179	0.8255
Organisational drivers (OD)	**Organisational strategy (OO)**	42				
	- Logistical infrastructure		OOLI	0.901	3.0000	0.8885
	- Within-company infrastructure		OOCI	0.901	3.0769	0.8701
	- Networks/contacts		OONC	0.901	3.9487	0.9719
	- Management team expertise		OOMT	0.901	4.5897	0.7152
	- Risk control		OORC	0.902	3.8718	0.7320
Entrepreneurial leadership capacity (ELC)	**Types of innovation (TI)**	28				
	- New to the world product or service		TINW	0.901	3.7436	1.0187
	- New to the firm product or service in line that at least one		TIFP	0.900	2.6923	1.2173

	competitor is offering					
	- New to the country and/or market product or service		TICM	0.901	2.9231	1.1329
	- New application of existing product or service, including application to a new market segment		TIEP	0.899	2.9231	1.2436
	- Addition to a company's existing product or service line		TIAP	0.900	2.7692	1.2662
	- Repositioning of an existing product or service		TIRP	0.899	2.3846	1.2485
	- Product/service improvement, revision, including application of new feature or option or change		TIPS	0.901	2.8974	1.2311
	- Process improvement for new administrative system or procedure		TINA	0.898	1.8205	1.0729
	- Process improvement for new production method		TINP	0.900	2.8974	1.3916
	- Process improvement for new marketing or sales approach		TINM	0.897	2.5385	1.4482
	- Process improvement for new customer support program		TINC	0.899	2.3590	1.1353
	- Process improvement for new logistical approach		TINL	0.900	2.1538	1.0647
	- Process improvement for new pricing approach		TIPR	0.899	2.4872	1.2112
	- Process improvement for new distribution channel or method		TIND	0.898	2.4615	1.3347
	- Process improvement for new financing method		TIFM	0.898	2.3590	1.2873
	- Process improvement for new purchasing technique		TIPT	0.900	1.9487	1.0748
	- Process improvement for new organisational form or structure		TIOF	0.898	2.0769	1.1784
	Recognition of innovation barriers (IB)	31				
	Financial					
	- Lack of venture capital in early stage of venture		IBVCE	0.902	3.9231	1.5455
	- Lack of public funds in early stage of venture		IBPFE	0.899	3.4103	1.3518
	- Lack of government research funds in early stage of venture		IBGRE	0.899	3.1795	1.2327
	- Lack of venture capital in late stage of venture		IBVCL	0.904	3.4615	1.4482
	- Lack of public funds in late stage of venture		IBPFL	0.901	3.8462	1.2256
	- Lack of government research funds in late stage of venture		IBGRL	0.902	3.0256	1.1807
	Regulatory					
	- Australian government regulations (eg state or federal)		IBAG	0.899	2.6923	1.3407
	- Foreign government regulations (eg CE/EMEA approval etc)		IBFG	0.899	3.3333	1.4204
	- Australian patent process		IBAP	0.898	2.4103	1.1173
	- Foreign patent process		IBFP	0.899	2.8205	1.1893
	- TGA approval process		IBTGA	0.900	3.0000	1.3572
	- FDA approval process		IBFDA	0.901	3.5641	1.5182

	Resource - Lack of skilled managers - Lack of skilled researchers - Lack of research facilities/assets - Lack of manufacturing facilities - Lack of marketing/distribution channels - Lack of clinical trial facilities		 IBSM IBSR IBRF IBMF IBMC IBCTG	 0.902 0.901 0.900 0.901 0.900 0.900	 3.6154 3.2051 2.8718 2.8974 2.8718 2.4103	 1.2485 1.2810 1.1512 1.1875 1.3215 1.2506
Entrepreneurial Process (EP)	**Presence of opportunity (PO)** - In market (eg needs, customers and potential market size) - In Economy (eg profits after tax and time to break even etc) - In competitive advantage (eg barrier to entry, and degree of control over costs and prices etc) - In network/management expertise/risk control	23	 POIM POIE POCA PONR	 0.901 0.900 0.901 0.900	 4.5385 3.5897 4.2564 3.6923	 0.6003 1.0935 0.8182 1.0040
	Opportunity recognition (OR) - Changing demographics - Emergence of new market segments - New process needs - New technologies - Incongruities/ Lack of harmony - Regulatory change - Social change		 ORCD ORNMS ORNPN ORNT ORILH ORRC ORSC	 0.900 0.900 0.898 0.903 0.899 0.900 0.899	 3.0000 3.7179 3.1795 3.8718 2.7179 3.3846 2.8718	 1.2354 1.0247 1.2327 0.8006 1.1227 1.2485 1.3014
	Decision for opportunity exploitation (DOE) - New products - New services - New processes - New markets - New organisational structure/forms - New technologies - New sales or distribution channels		 DOENP DOENS DOENPC DOENM DOENOS DOENT DOENSC	 0.901 0.901 0.899 0.903 0.900 0.900 0.899	 4.2051 2.6410 3.0769 3.8974 2.1795 4.1282 2.6923	 1.0558 1.2458 1.1559 1.0710 0.9699 0.8329 1.3984
	Resource acquisition (RA) - Skilled employees - General management expertise - Marketing and sales expertise - Technical expertise - Financing - Distribution - Source of supply - Production facilities - Licences, patents and legal protection		 RASE RAGME RAMSE RATE RAF RAD RASS RAPF RALP	 0.901 0.900 0.900 0.901 0.900 0.900 0.900 0.901 0.901	 4.0769 4.1026 3.5128 4.1538 4.3333 2.9744 3.2051 2.8718 4.4842	 0.8074 0.8824 1.2112 0.7448 0.7009 1.1807 0.9782 1.0047 0.7564
	Process management (PM) - Absorption of new concept into mainstream operations - Licensing of rights with other company - Calculating the uncertainty of opportunities/risk		 PMNC PMLR PMUO	 0.900 0.900 0.901	 3.6923 3.6923 3.9231	 0.8931 1.0552 0.7741

	- Company organisation design		PMOR	0.899	3.1538	0.9608
Enhanced organisational achievement (EOA)	**Business model (BM)**	36				
	- Strategic alliance with partners		BMSA	0.902	4.2821	0.8568
	- Refocussed current product development		BMRCP	0.900	3.2308	0.9857
	- Launch new products		BMLNP	0.900	3.8718	1.0306
	- Raised public capital		BMPUC	0.901	3.7949	1.0804
	- Raised private capital		BMPRC	0.901	3.5897	1.1173
	- Acquisition		BMA	0.902	3.0769	1.1329
	- Merger		BMM	0.902	2.8462	1.0647
	Enterprise performance (EP)	37				
	- Managerial skills		EPMS	0.900	4.4103	0.8182
	- Efficiency/speed of product development		EPEPD	0.901	3.7692	0.7420
	- Skilled labour		EPSL	0.901	4.0000	0.7609
	- Quality of product		EPQP	0.901	4.1282	0.8006
	- Marketing capability		EPMC	0.899	3.6923	1.1039
	- Collaboration with universities/research centres		EPCU	0.901	2.6154	0.9629
	- Government support		EPGS	0.901	3.0769	1.1559
	- Collaboration with industrial companies		EPCIC	0.901	3.4872	1.1441
	- Access to seed/venture capital		EPASV	0.903	3.7692	1.0628
	- Collaboration with other biotechnology companies		EPCBC	0.902	2.9487	1.1227
	- Access to domestic markets		EPDM	0.901	2.5385	1.2533
	- Physical proximity to collaborators		EPPPC	0.902	2.4615	0.9692
	- Access to international markets		EPAIM	0.900	3.9744	1.0127
	- Ability to recognise commercial application of technology		EPACA	0.902	4.6410	0.6684
	- Learning from end users		EPLEU	0.900	4.0256	1.0879
	- Technology transfer from suppliers/ inventors		EPTTI	0.902	3.5385	1.0475
	- Research capability		EPRC	0.900	3.5385	0.8840

APPENDIX E: Summary of exploratory factor analysis for 30 important factors after factor extraction - (1) Entrepreneurial types (ET) factors for construct measures

Type	Construct measure	Item	Rotated factor loadings				Total
			ETPA	ETSS	ETEI	ETRM	
Entrepreneur (EN)	**Entrepreneurial types (ET) (Q24)**						
	- Personal achiever	ETPA	0.167	-0.183	0.263	0.142	
	- Super' sales people	ETSS	-0.009	0.200	0.038	-0.148	
	- Expert idea generator	ETEI	0.167	-0.093	0.014	-0.023	
	- Real manager	ETRM	**0.678**	-0.167	-0.066	0.072	
External driver (ED)	**Market orientation (MO) (Q38)**						
	- Identified customer needs	MOIC	0.040	0.156	-0.076	-0.074	
	- Emerging industry	MOEI	0.178	0.295	0.051	**0.443**	
	- High market growth rate (eg 30-50%)	MOMR	0.216	-0.110	0.124	0.021	
	- High gross margin (eg 40-50%)	MOGM	-0.308	-0.158	-0.018	0.123	
	- Reasonable market share (eg 20%)	MOMS	0.183	-0.108	0.037	-0.064	
	Business climate (BC) (Q39)						
	- Good profit after tax (eg 10-15%)	BCPT	0.044	0.008	-0.181	0.058	
	- Short time to break even and positive cash flow (eg under 2 years)	BCBE	0.077	0.033	-0.206	0.306	
	- Low to moderate capital requirements	BCCR	0.073	0.164	-0.005	0.103	
	Competitive advantages (CA) (Q40)						
	- Low fixed and variable costs for production/marketing/distribution	CAFC	-0.103	-0.037	0.016	0.163	
	- Moderate to strong degree of control for prices/costs/channels of supply etc	CACP	0.036	0.109	-0.003	0.278	
	- Barriers to entry for proprietary protection/lead time/legal advantage	CABE	0.006	0.164	-0.145	0.047	
	- Product differentiation	CAPD	0.175	0.240	0.071	0.245	
	Environmental uncertainty (EU) (Q41)						
	- Political infrastructure in society	EUPI	0.006	-0.030	0.045	**0.866**	
	- Legal infrastructure	EULI	0.120	-0.156	0.012	**0.832**	
	- Regulatory infrastructure	EURI	0.179	0.049	0.060	0.259	
	- Socio-cultural infrastructure	EUSI	-0.057	-0.072	0.141	**0.636**	
	- Financial infrastructure	EUFI	0.089	-0.060	0.048	-0.022	
Organisational driver (OD)	**Organisational strategy (OO) (Q42)**						
	- Logistical infrastructure	OOLI	-0.166	0.126	0.012	0.384	
	- Within-company infrastructure	OOCI	-0.123	-0.023	-0.011	0.106	
	- Networks/contacts	OONC	0.228	0.128	-0.216	-0.212	
	- Management team expertise	OOMT	0.059	0.196	-0.113	0.039	
	- Risk control	OORC	0.011	-0.368	-0.083	0.038	
Entrepreneurial leadership capacity (ELC)	**Types of innovation (TI) (Q28)**						
	- New to the world product or service	TINW	0.084	-0.036	0.155	-0.296	
	- New to the firm product or service in line that at least one competitor is offering	TIFP	**0.497**	0.049	-0.018	-0.072	
	- New to the country and/or market product or service	TICM	0.042	-0.001	0.246	-0.052	
	- New application of existing product or service, including application to a new market segment	TIEP	**0.453**	0.102	0.142	-0.077	
	- Addition to a company's existing product or service line	TIAP	0.357	0.049	0.035	0.006	
	- Repositioning of an existing product or service	TIRP	**0.489**	0.049	0.085	-0.173	
	- Product/service improvement, revision, including application of new feature or option or change	TIPS	0.242	-0.139	-0.013	-0.044	
	- Process improvement for new	TINA	**0.738**	0.000	-0.065	0.075	

	administrative system or procedure						
	- Process improvement for new production method	TINP	**0.457**	0.072	-0.090	0.220	
	- Process improvement for new marketing or sales approach	TINM	**0.797**	0.265	-0.006	-0.048	
	- Process improvement for new customer support program	TINC	**0.855**	0.041	0.044	-0.193	
	- Process improvement for new logistical approach	TINL	**0.765**	0.140	0.124	0.091	
	- Process improvement for new pricing approach	TIPR	**0.751**	-0.100	0.215	-0.068	
	- Process improvement for new distribution channel or method	TIND	**0.761**	0.142	0.052	-0.037	
	- Process improvement for new financing method	TIFM	**0.831**	-0.028	0.007	0.127	
	- Process improvement for new purchasing technique	TIPT	**0.664**	-0.001	0.206	0.204	
	- Process improvement for new organisational form or structure	TIOF	**0.759**	0.015	-0.050	0.228	
	Recognition of innovation barriers (IB) (Q31)						
	Financial						
	- Lack of venture capital in early stage of venture	IBVCE	0.042	0.117	-0.157	-0.138	
	- Lack of public funds in early stage of venture	IBPFE	0.296	0.070	-0.071	0.194	
	- Lack of government research funds in early stage of venture	IBGRE	0.153	0.228	0.175	0.128	
	- Lack of venture capital in late stage of venture	IBVCL	-0.277	-0.074	-0.096	0.152	
	- Lack of public funds in late stage of venture	IBPFL	-0.038	-0.061	0.318	0.152	
	- Lack of government research funds in late stage of venture	IBGRL	-0.079	0.017	0.052	0.159	
	Regulatory						
	- Australian government regulations (eg state or federal)	IBAG	0.111	0.187	**0.766**	0.147	
	- Foreign government regulations (eg CE/EMEA approval etc)	IBFG	0.158	-0.016	**0.883**	0.133	
	- Australian patent process	IBAP	0.247	0.203	0.320	0.170	
	- Foreign patent process	IBFP	0.200	0.192	0.269	0.179	
	- TGA approval process	IBTGA	0.038	0.144	**0.868**	-0.082	
	- FDA approval process	IBFDA	-0.059	-0.005	**0.910**	-0.020	
	Resource						
	- Lack of skilled managers	IBSM	-0.023	-0.051	0.121	0.036	
	- Lack of skilled researchers	IBSR	0.171	0.260	0.240	-0.321	
	- Lack of research facilities/assets	IBRF	-0.063	0.286	0.214	-0.094	
	- Lack of manufacturing facilities	IBMF	-0.018	-0.013	0.322	0.134	
	- Lack of marketing/distribution channels	IBMC	0.155	0.205	0.186	-0.073	
	- Lack of clinical trial facilities	IBCTG	0.065	0.088	0.325	0.167	

Entrepreneurial Process (EP)	**Presence of opportunity (PO) (Q23)**						
	- In market (eg needs, customers and potential market size)	POIM	-0.061	-0.055	0.152	-0.050	
	- In Economy (eg profits after tax and time to break even etc)	POIE	0.197	**0.425**	-0.076	0.156	
	- In competitive advantage (eg barrier to entry, and degree of control over costs and prices etc)	POCA	0.082	0.110	0.115	0.018	
	- In network/management expertise/risk control	PONR	0.003	0.387	-0.045	0.113	
	Opportunity recognition (OR) (Q23)						
	- Changing demographics	ORCD	0.175	0.096	0.091	**0.550**	
	- Emergence of new market segments	ORNMS	**0.432**	0.165	0.166	0.246	
	- New process needs	ORNPN	0.378	0.167	0.255	0.210	
	- New technologies	ORNT	-0.336	0.241	0.135	-0.254	
	- Incongruities/ Lack of harmony	ORILH	0.301	0.107	0.224	0.136	
	- Regulatory change	ORRC	0.383	-0.127	0.155	0.370	
	- Social change	ORSC	0.293	0.195	0.084	0.326	
	Decision for opportunity exploitation (DOE) (Q23)						
	- New products	DOENP	0.210	0.122	-0.093	-0.341	
	- New services	DOENS	0.052	0.308	-0.100	-0.193	
	- New processes	DOENPC	0.351	0.084	0.117	-0.033	
	- New markets	DOENM	0.216	0.044	-0.135	-0.202	
	- New organisational structure/forms	DOENOS	0.390	0.196	-0.304	-0.037	
	- New technologies	DOENT	0.082	0.097	0.200	0.073	
	- New sales or distribution channels	DOENSC	**0.462**	0.358	-0.096	-0.226	
	Resource acquisition (RA) (Q23)						
	- Skilled employees	RASE	-0.035	0.189	0.290	0.020	
	- General management expertise	RAGME	0.251	0.236	0.060	0.230	
	- Marketing and sales expertise	RAMSE	0.082	**0.874**	0.065	-0.138	
	- Technical expertise	RATE	-0.059	0.050	0.234	0.109	
	- Financing	RAF	-0.134	**0.546**	0.027	0.080	
	- Distribution	RAD	0.107	**0.909**	0.056	0.014	
	- Source of supply	RASS	0.043	**0.490**	0.226	0.012	
	- Production facilities	RAPF	0.120	0.219	-0.098	0.356	
	- Licences, patents and legal protection	RALP	-0.100	0.028	-0.096	0.234	
	Process management (PM) (Q23)						
	- Absorption of new concept into mainstream operations	PMNC	0.155	0.176	0.123	0.215	
	- Licensing of rights with other company	PMLR	0.136	0.003	-0.104	0.151	
	- Calculating the uncertainty of opportunities/risk	PMUO	0.125	0.004	-0.047	0.192	
	- Company organisation design	PMOR	**0.423**	0.228	-0.185	0.222	
Enhanced organisational achievement (EOA)	**Business model (BM) (Q36)**						
	- Strategic alliance with partners	BMSA	-0.341	-0.023	-0.261	-0.020	
	- Refocussed current product development	BMRCP	0.125	0.098	0.106	-0.033	
	- Launch new products	BMLNP	0.110	0.222	0.293	-0.232	
	- Raised public capital	BMPUC	-0.044	0.104	0.125	0.010	
	- Raised private capital	BMPRC	-0.098	0.055	0.074	-0.179	
	- Acquisition	BMA	-0.147	-0.177	-0.059	0.055	
	- Merger	BMM	-0.014	-0.057	-0.121	0.103	
	Enterprise performance (EP) (Q37)						
	- Managerial skills	EPMS	0.040	0.185	0.168	0.180	
	- Efficiency/speed of product development	EPEPD	-0.083	**0.447**	0.006	0.025	
	- Skilled labour	EPSL	-0.007	0.028	0.036	-0.096	
	- Quality of product	EPQP	0.201	0.048	0.032	-0.060	
	- Marketing capability	EPMC	0.346	**0.618**	0.125	-0.125	
	- Collaboration with	EPCU	-0.031	0.010	-0.013	-0.036	

	universities/research centres						
	- Government support	EPGS	-0.079	-0.163	0.081	-0.250	
	- Collaboration with industrial companies	EPCIC	-0.126	-0.180	0.119	0.226	
	- Access to seed/venture capital	EPASV	-0.038	-0.161	-0.141	0.151	
	- Collaboration with other biotechnology companies	EPCBC	0.002	-0.136	-0.081	-0.013	
	- Access to domestic markets	EPDM	0.127	0.080	**0.422**	-0.198	
	- Physical proximity to collaborators	EPPPC	-0.126	0.178	-0.014	0.007	
	- Access to international markets	EPAIM	0.062	0.038	0.162	0.175	
	- Ability to recognise commercial application of technology	EPACA	-0.084	-0.083	-0.080	-0.016	
	- Learning from end users	EPLEU	0.007	**0.606**	0.240	0.039	
	- Technology transfer from suppliers/ inventors	EPTTI	-0.107	0.125	0.086	-0.111	
	- Research capability	EPRC	0.144	-0.066	-0.016	-0.121	
	Eigenvalues		10.024	5.667	5.486	5.283	26.46
	% of variance		8.641	4.886	4.729	4.554	22.81
	Alpha coefficient (α)		0.901	0.902	0.900	0.900	

Note: Factor loadings over 0.40 appear in **bold and underlined**.

APPENDIX F: Summary of exploratory factor analysis for 30 important factors after factor extraction - (2) Market Orientation (MO) factors for construct measures

			Rotated factor loadings					
Type	Construct measure	Item	MOIC	MOEI	MOMR	MOGM	MOMS	Total
Entrepreneur (EN)	**Entrepreneurial types (ET) (Q24)**							
	- Personal achiever	ETPA	0.070	0.010	-0.201	-0.063	0.153	
	- Super' sales people	ETSS	0.027	0.036	0.051	-0.068	-0.089	
	- Expert idea generator	ETEI	0.351	0.131	-0.059	0.088	-0.030	
	- Real manager	ETRM	0.027	-0.160	-0.008	0.383	0.130	
External driver (ED)	**Market orientation (MO) (Q38)**							
	- Identified customer needs	MOIC	0.050	0.018	0.039	-0.077	0.250	
	- Emerging industry	MOEI	0.084	-0.175	-0.121	-0.083	-0.200	
	- High market growth rate (eg 30-50%)	MOMR	-0.324	-0.043	0.106	-0.004	0.131	
		MOGM	0.100	0.149	0.085	-0.223	0.147	
	- High gross margin (eg 40-50%)	MOMS	0.150	0.143	0.025	-0.043	0.002	
	- Reasonable market share (eg 20%)							
	Business climate (BC) (Q39)	BCPT	0.230	0.008	0.087	-0.105	0.157	
	- Good profit after tax (eg 10-15%)	BCBE	-0.11	0.352	0.037	-0.133	0.323	
	- Short time to break even and positive cash flow (eg under 2 years)	BCCR	0.100	-0.003	0.115	-0.039	0.079	
	- Low to moderate capital requirements							
		CAFC	-0.035	-0.064	-0.074	-0.064	-0.104	
	Competitive advantages (CA) (Q40)							
	- Low fixed and variable costs for production/marketing/distribution	CACP	0.114	-0.030	-0.043	0.135	0.101	
	- Moderate to strong degree of control for prices/costs/channels of supply etc	CABE	0.026	-0.091	-0.243	0.102	0.013	
	- Barriers to entry for proprietary protection/lead time/legal advantage	CAPD	0.208	0.226	-0.329	-0.202	-0.017	
	- Product differentiation							
	Environmental uncertainty (EU) (Q41)	EUPI	-0.078	-0.008	0.056	0.128	-0.017	
		EULI	0.259	0.048	-0.001	0.160	-0.094	
	- Political infrastructure in society	EURI	-0.009	0.008	-0.007	0.156	-0.038	
	- Legal infrastructure	EUSI	0.055	-0.066	-0.023	0.118	0.006	
	- Regulatory infrastructure	EUFI	0.297	0.361	0.102	0.131	-0.158	
	- Socio-cultural infrastructure							
	- Financial infrastructure							
Organisational driver (OD)	**Organisational strategy (OO) (Q42)**							
	- Logistical infrastructure	OOLI	0.061	0.173	**-0.483**	-0.058	0.104	
	- Within-company infrastructure	OOCI	0.343	0.133	0.225	-0.029	0.215	
	- Networks/contacts	OONC	-0.021	0.018	-0.120	-0.078	0.086	
	- Management team expertise	OOMT	0.109	0.001	-0.033	-0.033	-0.205	
	- Risk control	OORC	-0.121	-0.096	-0.154	0.064	-0.182	
Entrepreneurial leadership capacity (ELC)	**Types of innovation (TI) (Q28)**							
	- New to the world product or service	TINW	0.142	0.278	0.032	**0.440**	-0.056	
	- New to the firm product or service in line that at least one competitor is offering	TIFP	0.212	-0.156	-0.202	0.089	0.194	
	- New to the country and/or market product or service	TICM	0.035	0.036	0.026	0.151	-0.072	
	- New application of existing product or service, including application to a new market segment	TIEP	-0.148	0.049	0.245	-0.072	0.116	
	- Addition to a company's existing product or service line	TIAP	0.111	-0.068	-0.054	0.126	0.118	
	- Repositioning of an existing product or service	TIRP	-0.144	0.190	0.054	0.150	0.122	
	- Product/service improvement, revision, including application of new	TIPS	-0.063	-0.057	-0.120	0.054	0.072	

	feature or option or change							
	- Process improvement for new administrative system or procedure	TINA	-0.116	-0.076	0.142	0.056	-0.097	
	- Process improvement for new production method	TINP	-0.108	-0.036	0.072	0.297	-0.012	
	- Process improvement for new marketing or sales approach	TINM	-0.124	-0.020	0.029	-0.115	0.053	
	- Process improvement for new customer support program	TINC	0.034	0.013	-0.036	-0.068	-0.019	
	- Process improvement for new logistical approach	TINL	-0.057	-0.011	-0.074	-0.064	-0.127	
	- Process improvement for new pricing approach	TIPR	-0.175	0.041	-0.115	-0.137	0.086	
	- Process improvement for new distribution channel or method	TIND	-0.100	0.053	0.138	-0.245	0.025	
	- Process improvement for new financing method	TIFM	0.057	0.046	-0.164	0.040	-0.068	
	- Process improvement for new purchasing technique	TIPT	0.253	0.050	-0.013	0.068	0.019	
	- Process improvement for new organisational form or structure	TIOF	0.022	0.016	0.175	-0.015	0.054	
	<u>**Recognition of innovation barriers (IB) (Q31)**</u>							
	<u>Financial</u>							
	- Lack of venture capital in early stage of venture	IBVCE	-0.174	0.053	0.078	0.250	0.060	
	- Lack of public funds in early stage of venture	IBPFE	0.059	0.019	0.058	0.003	-0.023	
	- Lack of government research funds in early stage of venture	IBGRE	-0.047	0.100	0.276	<u>**0.400**</u>	-0.194	
	- Lack of venture capital in late stage of venture	IBVCL	-0.144	-0.053	-0.072	<u>**0.574**</u>	-0.133	
	- Lack of public funds in late stage of venture	IBPFL	-0.050	-0.217	0.058	<u>**0.622**</u>	0.034	
	- Lack of government research funds in late stage of venture	IBGRL	0.016	0.021	0.077	<u>**0.884**</u>	-0.007	
	<u>Regulatory</u>							
	- Australian government regulations (eg state or federal)	IBAG	-0.065	0.016	0.181	-0.018	-0.062	
	- Foreign government regulations (eg CE/EMEA approval etc)	IBFG	-0.023	0.040	0.262	0.076	0.036	
	- Australian patent process	IBAP	-0.198	0.275	0.258	0.125	0.012	
	- Foreign patent process	IBFP	-0.258	0.234	0.268	0.242	-0.099	
	- TGA approval process	IBTGA	0.036	0.108	-0.029	0.048	0.105	
	- FDA approval process	IBFDA	-0.152	-0.097	0.090	0.032	0.055	
	<u>Resource</u>							
	- Lack of skilled managers	IBSM	-0.131	0.031	0.165	-0.038	0.008	
	- Lack of skilled researchers	IBSR	0.045	0.181	0.326	0.122	0.148	
	- Lack of research facilities/assets	IBRF	0.109	0.097	<u>**0.718**</u>	0.161	-0.016	
	- Lack of manufacturing facilities	IBMF	0.029	-0.020	<u>**0.836**</u>	-0.12	-0.016	
	- Lack of marketing/distribution channels	IBMC	-0.148	0.015	0.091	0.191	0.228	
	- Lack of clinical trial facilities	IBCTG	-0.090	0.170	<u>**0.468**</u>	-0.043	0.217	

Entrepreneurial Process (EP)	**<u>Presence of opportunity (PO) (Q23)</u>**							
	- In market (eg needs, customers and potential market size)	POIM	0.025	0.103	0.024	-0.093	**<u>0.456</u>**	
	- In Economy (eg profits after tax and time to break even etc)	POIE	0.002	0.065	-0.140	-0.091	0.395	
	- In competitive advantage (eg barrier to entry, and degree of control over costs and prices etc)	POCA	0.035	0.128	-0.133	-0.175	0.107	
	- In network/management expertise/risk control	PONR	-0.069	**<u>0.432</u>**	0.085	-0.143	0.013	
	<u>Opportunity recognition (OR) (Q23)</u>	ORCD	0.119	-0.168	-0.024	-0.046	0.212	
	- Changing demographics	ORNMS	0.301	-0.246	0.301	0.111	0.149	
	- Emergence of new market segments	ORNPN	0.224	0.114	0.064	0.059	-0.150	
	- New process needs	ORNT	0.221	0.146	-0.090	0.157	-0.156	
	- New technologies	ORILH	-0.121	-0.015	0.184	-0.026	-0.080	
	- Incongruities/ Lack of harmony	ORRC	-0.149	-0.078	-0.007	0.013	0.006	
	- Regulatory change	ORSC	0.073	0.085	0.245	-0.255	0.006	
	- Social change							
	<u>Decision for opportunity exploitation (DOE) (Q23)</u>	DOENP	-0.074	0.329	-0.094	-0.071	0.181	
	- New products	DOENS	0.094	-0.090	0.170	0.024	-0.102	
	- New services	DOENPC	0.271	0.170	-0.102	0.269	0.003	
	- New processes	DOENM	-0.238	-0.137	-0.133	-0.179	-0.104	
	- New markets	DOENOS	-0.012	-0.147	0.141	0.003	-0.074	
	- New organisational structure/forms	DOENT	0.028	**<u>0.553</u>**	0.069	0.264	-0.171	
	- New technologies	DOENSC	0.027	-0.117	-0.033	0.123	-0.138	
	- New sales or distribution channels							
	<u>Resource acquisition (RA) (Q23)</u>	RASE	0.109	-0.199	0.007	0.057	**<u>0.684</u>**	
	- Skilled employees	RAGME	-0.052	0.077	-0.396	-0.028	0.074	
	- General management expertise	RAMSE	-0.040	-0.104	0.041	0.056	0.070	
	- Marketing and sales expertise	RATE	-0.156	0.130	-0.146	0.134	0.259	
	- Technical expertise	RAF	-0.140	0.093	-0.078	0.202	0.051	
	- Financing	RAD	-0.121	-0.001	0.040	-0.050	-0.049	
	- Distribution	RASS	-0.030	-0.084	0.234	0.196	0.008	
	- Source of supply	RAPF	0.068	-0.295	0.192	0.236	-0.211	
	- Production facilities	RALP	0.092	0.157	0.226	-0.048	0.005	
	- Licences, patents and legal protection							
		PMNC	0.006	-0.006	0.039	0.047	0.064	
	<u>Process management (PM) (Q23)</u>							
	- Absorption of new concept into mainstream operations	PMLR	0.269	0.149	-0.036	0.023	-0.097	
	- Licensing of rights with other company	PMUO	-0.083	0.086	-0.064	-0.100	0.040	
	- Calculating the uncertainty of opportunities/risk	PMOR	-0.081	-0.010	-0.209	-0.131	**<u>0.430</u>**	
	- Company organisation design							
Enhanced organisational achievement (EOA)	**<u>Business model (BM) (Q36)</u>**							
	- Strategic alliance with partners	BMSA	0.134	0.272	-0.016	-0.199	-0.043	
	- Refocussed current product development	BMRCP	0.245	0.101	-0.079	-0.018	0.044	
	- Launch new products	BMLNP	0.039	-0.136	-0.147	0.004	0.054	
	- Raised public capital	BMPUC	0.133	-0.093	0.130	0.197	0.152	
	- Raised private capital	BMPRC	-0.119	0.164	-0.149	0.051	0.016	
	- Acquisition	BMA	**<u>0.879</u>**	0.065	0.018	-0.112	-0.025	
	- Merger	BMM	**<u>0.893</u>**	0.006	0.048	0.069	-0.007	
	<u>Enterprise performance (EP) (Q37)</u>							
	- Managerial skills	EPMS	0.262	0.008	0.011	0.004	0.072	
	- Efficiency/speed of product development	EPEPD	-0.204	0.243	-0.035	-0.034	0.318	
	- Skilled labour	EPSL	-0.056	0.036	-0.003	-0.048	**<u>0.883</u>**	
	- Quality of product	EPQP	-0.125	-0.083	0.177	0.116	**<u>0.422</u>**	

	- Marketing capability	EPMC	-0.267	0.193	0.057	0.001	0.244	
	- Collaboration with universities/research centres	EPCU	0.030	**<u>0.877</u>**	-0.004	-0.056	0.041	
	- Government support	EPGS	0.086	**<u>0.574</u>**	0.040	0.105	-0.008	
	- Collaboration with industrial companies	EPCIC	0.085	**<u>0.458</u>**	0.081	-0.141	-0.179	
	- Access to seed/venture capital	EPASV	0.107	0.037	-0.163	0.139	-0.080	
	- Collaboration with other biotechnology companies	EPCBC	**<u>0.414</u>**	**<u>0.447</u>**	-0.070	-0.207	-0.029	
	- Access to domestic markets	EPDM	0.076	-0.057	-0.062	-0.326	-0.033	
	- Physical proximity to collaborators	EPPPC	0.308	0.366	-0.316	-0.051	-0.238	
	- Access to international markets	EPAIM	0.129	0.149	0.076	-0.112	-0.153	
	- Ability to recognise commercial application of technology	EPACA	0.037	-0.021	-0.048	-0.003	0.039	
	- Learning from end users	EPLEU	0.185	-0.072	0.024	-0.243	0.134	
	- Technology transfer from suppliers/ inventors	EPTTI	0.278	0.183	0.078	0.008	-0.062	
	- Research capability	EPRC	0.157	0.333	-0.135	0.131	-0.027	
	Eigenvalues		4.167	4.114	3.783	3.774	3.573	19.41
	% of variance		3.593	3.547	3.261	3.254	3.080	16.74
	Alpha coefficient (α)		0.902	0.901	0.901	0.902	0.900	

Note: Factor loadings over 0.40 appear in **<u>bold and underlined</u>**.

APPENDIX G: Summary of exploratory factor analysis for 30 important factors after factor extraction - (3) Business Climate (BC) factors for construct measures

			Rotated factor loadings			
Type	Construct measure	Item	BCPT	BCBE	BCCR	Total
Entrepreneur (EN)	**Entrepreneurial types (ET) (Q24)**					
	- Personal achiever	ETPA	-0.074	0.087	-0.201	
	- Super' sales people	ETSS	0.0006	0.015	-0.067	
	- Expert idea generator	ETEI	**0.757**	0.087	0.074	
	- Real manager	ETRM	0.124	-0.063	0.171	
External driver (ED)	**Market orientation (MO) (Q38)**					
	- Identified customer needs	MOIC	0.015	-0.039	**-0.841**	
	- Emerging industry	MOEI	0.106	-0.285	0.017	
	- High market growth rate (eg 30-50%)	MOMR	0.014	-0.074	-0.124	
	- High gross margin (eg 40-50%)	MOGM	0.000	0.038	-0.210	
	- Reasonable market share (eg 20%)	MOMS	-0.007	0.064	-0.106	
	Business climate (BC) (Q39)					
	- Good profit after tax (eg 10-15%)	BCPT	-0.185	-.0178	-0.355	
	- Short time to break even and positive cash flow (eg under 2 years)	BCBE	-0.100	**-0.423**	0.110	
	- Low to moderate capital requirements	BCCR	0.035	-0.031	**0.819**	
	Competitive advantages (CA) (Q40)					
	- Low fixed and variable costs for production/marketing/distribution	CAFC	0.001	-0.061	0.244	
	- Moderate to strong degree of control for prices/costs/channels of supply etc	CACP	0.106	0.024	-0.136	
	- Barriers to entry for proprietary protection/lead time/legal advantage	CABE	-0.128	-0.299	-0.359	
	- Product differentiation	CAPD	0.227	-0.252	-0.187	
	Environmental uncertainty (EU) (Q41)					
	- Political infrastructure in society	EUPI	-0.077	0.136	0.111	
	- Legal infrastructure	EULI	0.102	0.029	-0.026	
	- Regulatory infrastructure	EURI	-0.258	0.166	0.034	
	- Socio-cultural infrastructure	EUSI	-0.023	-0.248	0.139	
	- Financial infrastructure	EUFI	-0.073	-0.147	0.085	
Organisational driver (OD)	**Organisational strategy (OO) (Q42)**					
	- Logistical infrastructure	OOLI	-0.086	0.033	0.073	
	- Within-company infrastructure	OOCI	-0.153	0.276	0.020	
	- Networks/contacts	OONC	0.001	-0.066	0.104	
	- Management team expertise	OOMT	-0.009	-0.124	0.075	
	- Risk control	OORC	0.149	-0.035	0.150	
Entrepreneurial leadership capacity (ELC)	**Types of innovation (TI) (Q28)**					
	- New to the world product or service	TINW	-0.164	0.081	-0.042	
	- New to the firm product or service in line that at least one competitor is offering	TIFP	-0.092	-0.036	0.068	
	- New to the country and/or market product or service	TICM	**-0.790**	0.045	0.020	
	- New application of existing product or service, including application to a new market segment	TIEP	-0.160	-0.120	0.108	
	- Addition to a company's existing product or service line	TIAP	-0.031	0.111	0.018	
	- Repositioning of an existing product or service	TIRP	0.171	-0.085	-0.023	
	- Product/service improvement, revision, including application of new feature or option or change	TIPS	-0.074	-0.065	-0.046	

	- Process improvement for new administrative system or procedure	TINA	0.081	0.028	0.117	
	- Process improvement for new production method	TINP	-0.175	-0.158	0.080	
	- Process improvement for new marketing or sales approach	TINM	0.138	0.130	0.000	
	- Process improvement for new customer support program	TINC	0.063	0.165	-0.006	
	- Process improvement for new logistical approach	TINL	-0.105	-0.185	-0.246	
	- Process improvement for new pricing approach	TIPR	-0.271	-0.087	0.075	
	- Process improvement for new distribution channel or method	TIND	0.126	0.064	0.155	
	- Process improvement for new financing method	TIFM	0.023	-0.113	0.065	
	- Process improvement for new purchasing technique	TIPT	-0.088	-0.032	-0.311	
	- Process improvement for new organisational form or structure	TIOF	-0.025	0.173	-0.152	
	Recognition of innovation barriers (IB) (Q31)					
	Financial					
	- Lack of venture capital in early stage of venture	IBVCE	-0.242	0.056	0.049	
	- Lack of public funds in early stage of venture	IBPFE	0.104	-0.030	-0.002	
	- Lack of government research funds in early stage of venture	IBGRE	0.015	0.044	0.127	
	- Lack of venture capital in late stage of venture	IBVCL	-0.119	-0.001	0.093	
	- Lack of public funds in late stage of venture	IBPFL	-0.123	-0.040	-0.002	
	- Lack of government research funds in late stage of venture	IBGRL	0.001	-0.143	0.007	
	Regulatory					
	- Australian government regulations (eg state or federal)	IBAG	0.167	0.285	-0.024	
	- Foreign government regulations (eg CE/EMEA approval etc)	IBFG	-0.015	0.029	0.058	
	- Australian patent process	IBAP	-0.089	0.145	0.131	
	- Foreign patent process	IBFP	0.000	0.062	0.029	
	- TGA approval process	IBTGA	-0.140	-0.039	0.014	
	- FDA approval process	IBFDA	-0.045	-0.058	0.018	
	Resource					
	- Lack of skilled managers	IBSM	-0.037	-0.002	-0.193	
	- Lack of skilled researchers	IBSR	-0.080	-0.132	-0.099	
	- Lack of research facilities/assets	IBRF	0.007	0.072	-0.147	
	- Lack of manufacturing facilities	IBMF	-0.070	-0.081	0.139	
	- Lack of marketing/distribution channels	IBMC	0.245	0.031	0.051	
	- Lack of clinical trial facilities	IBCTG	-0.032	0.049	0.227	

Entrepreneurial Process (EP)	**Presence of opportunity (PO) (Q23)**					
	- In market (eg needs, customers and potential market size)	POIM	0.357	0.210	0.004	
	- In Economy (eg profits after tax and time to break even etc)	POIE	0.213	0.022	0.056	
	- In competitive advantage (eg barrier to entry, and degree of control over costs and prices etc)	POCA	0.038	**0.810**	-0.019	
	- In network/management expertise/risk control	PONR	0.145	0.133	0.054	
	Opportunity recognition (OR) (Q23)					
	- Changing demographics	ORCD	0.111	0.342	-0.059	
	- Emergence of new market segments	ORNMS	0.107	0.079	-0.070	
	- New process needs	ORNPN	0.281	-0.142	-0.122	
	- New technologies	ORNT	0.286	0.250	-0.165	
	- Incongruities/ Lack of harmony	ORILH	0.159	0.045	-0.036	
	- Regulatory change	ORRC	0.232	-0.210	-0.019	
	- Social change	ORSC	0.332	-0.027	0.064	
	Decision for opportunity exploitation (DOE) (Q23)					
	- New products	DOENP	-0.144	0.363	-0.168	
	- New services	DOENS	-0.027	0.046	-0.200	
	- New processes	DOENPC	0.178	-0.066	0.233	
	- New markets	DOENM	-0.018	-0.037	-0.044	
	- New organisational structure/forms	DOENOS	-0.126	0.038	-0.087	
	- New technologies	DOENT	0.132	0.259	0.288	
	- New sales or distribution channels	DOENSC	0.004	-0.058	0.219	
	Resource acquisition (RA) (Q23)					
	- Skilled employees	RASE	-0.112	0.099	-0.240	
	- General management expertise	RAGME	0.369	0.145	-0.005	
	- Marketing and sales expertise	RAMSE	-0.130	-0.008	-0.198	
	- Technical expertise	RATE	0.070	0.261	-0.123	
	- Financing	RAF	-0.087	0.209	0.110	
	- Distribution	RAD	0.059	0.026	0.072	
	- Source of supply	RASS	0.136	0.081	-0.032	
	- Production facilities	RAPF	0.160	-0.019	0.039	
	- Licences, patents and legal protection	RALP	0.061	**0.653**	0.132	
	Process management (PM) (Q23)					
	- Absorption of new concept into mainstream operations	PMNC	0.126	0.063	0.012	
	- Licensing of rights with other company	PMLR	0.030	0.251	0.134	
	- Calculating the uncertainty of opportunities/risk	PMUO	0.061	0.129	0.069	
	- Company organisation design	PMOR	0.111	-0.079	0.021	
Enhanced organisational achievement (EOA)	**Business model (BM) (Q36)**					
	- Strategic alliance with partners	BMSA	-0.030	0.247	0.206	
	- Refocussed current product development	BMRCP	-0.030	0.015	-0.040	
	- Launch new products	BMLNP	0.074	0.079	0.237	
	- Raised public capital	BMPUC	0.041	0.056	0.214	
	- Raised private capital	BMPRC	0.009	0.037	0.051	
	- Acquisition	BMA	0.163	-0.13	0.031	
	- Merger	BMM	0.004	0.058	-0.006	
	Enterprise performance (EP) (Q37)					
	- Managerial skills	EPMS	0.288	-0.045	0.021	
	- Efficiency/speed of product development	EPEPD	**0.497**	0.266	0.116	
	- Skilled labour	EPSL	0.058	-0.014	-0.080	
	- Quality of product	EPQP	0.089	0.270	0.280	
	- Marketing capability	EPMC	0.122	-0.128	0.086	
	- Collaboration with	EPCU	0.037	0.026	-0.129	

	universities/research centres					
	- Government support	EPGS	0.147	0.151	0.087	
	- Collaboration with industrial companies	EPCIC	0.351	0.339	0.241	
	- Access to seed/venture capital	EPASV	0.051	0.098	0.000	
	- Collaboration with other biotechnology companies	EPCBC	-0.020	0.133	-0.341	
	- Access to domestic markets	EPDM	-0.124	-0.205	0.059	
	- Physical proximity to collaborators	EPPPC	-0.060	-0.185	-0.107	
	- Access to international markets	EPAIM	0.058	-0.106	-0.010	
	- Ability to recognise commercial application of technology	EPACA	-0.109	0.129	0.054	
	- Learning from end users	EPLEU	-0.053	0.096	0.127	
	- Technology transfer from suppliers/ inventors	EPTTI	-0.010	0.027	0.089	
	- Research capability	EPRC	0.171	0.182	0.216	
	Eigenvalues		3.518	3.489	3.482	10.49
	% of variance		3.033	3.008	3.001	9.04
	Alpha coefficient (α)		0.902	0.902	0.901	

Note: Factor loadings over 0.40 appear in **bold and underlined**.

APPENDIX H: Summary of exploratory factor analysis for 30 important factors after factor extraction - (4) Competitive Advantages (CA) factors for construct measures

Type	Construct measure	Item	Rotated factor loadings				Total
			CAFC	CACP	CABE	CAPD	
Entrepreneur (EN)	**Entrepreneurial types (ET) (Q24)**						
	- Personal achiever	ETPA	**0.575**	0.038	-0.098	-0.232	
	- Super' sales people	ETSS	-0.047	-0.076	-0.048	-0.122	
	- Expert idea generator	ETEI	0.116	0.064	0.064	-0.012	
	- Real manager	ETRM	0.103	-0.002	-0.139	0.071	
External driver (ED)	**Market orientation (MO) (Q38)**						
	- Identified customer needs	MOIC	-0.145	-0.044	0.108	-0.006	
	- Emerging industry	MOEI	-0.013	0.033	0.004	0.062	
	- High market growth rate (eg 30-50%)	MOMR	0.046	-0.051	-0.045	**0.517**	
	- High gross margin (eg 40-50%)	MOGM	-0.060	-0.147	0.032	**0.593**	
	- Reasonable market share (eg 20%)	MOMS	0.075	0.098	-0.017	0.068	
	Business climate (BC) (Q39)						
	- Good profit after tax (eg 10-15%)	BCPT	0.350	-0.209	0.025	0.149	
	- Short time to break even and positive cash flow (eg under 2 years)	BCBE	-0.013	0.189	0.053	-0.185	
	- Low to moderate capital requirements	BCCR	0.006	-0.086	0.069	0.015	
	Competitive advantages (CA) (Q40)						
	- Low fixed and variable costs for production/marketing/distribution	CAFC	-0.002	0.056	-0.025	0.023	
	- Moderate to strong degree of control for prices/costs/channels of supply etc	CACP	-0.027	-0.221	-0.025	0.093	
	- Barriers to entry for proprietary protection/lead time/legal advantage	CABE	-0.086	-0.069	0.035	0.331	
	- Product differentiation	CAPD	-0.322	-0.102	-0.068	0.005	
	Environmental uncertainty (EU) (Q41)						
	- Political infrastructure in society	EUPI	0.080	0.166	-0.081	0.075	
	- Legal infrastructure	EULI	-0.008	0.043	-0.039	-0.021	
	- Regulatory infrastructure	EURI	0.146	0.037	-0.102	-0.002	
	- Socio-cultural infrastructure	EUSI	-0.070	0.034	0.124	0.252	
	- Financial infrastructure	EUFI	0.078	0.130	-0.216	0.170	
Organisational driver (OD)	**Organisational strategy (OO) (Q42)**						
	- Logistical infrastructure	OOLI	-0.029	-0.214	0.068	0.034	
	- Within-company infrastructure	OOCI	-0.148	0.055	0.179	0.194	
	- Networks/contacts	OONC	0.150	0.043	0.013	**0.595**	
	- Management team expertise	OOMT	-0.055	-0.090	-0.192	0.246	
	- Risk control	OORC	0.156	-0.103	-0.115	**0.471**	
Entrepreneurial leadership capacity (ELC)	**Types of innovation (TI) (Q28)**						
	- New to the world product or service	TINW	0.270	-0.015	-0.261	0.057	
	- New to the firm product or service in line that at least one competitor is offering	TIFP	-0.024	-0.070	0.028	0.057	
	- New to the country and/or market product or service	TICM	0.150	0.037	0.025	-0.013	
	- New application of existing product or service, including application to a new market segment	TIEP	-0.046	0.098	0.132	0.017	
	- Addition to a company's existing product or service line	TIAP	0.023	-0.123	0.114	-0.047	
	- Repositioning of an existing product or service	TIRP	0.013	-0.091	**0.408**	-0.111	
	- Product/service improvement, revision, including application of new feature or option or change	TIPS	-0.015	0.136	0.068	-0.055	
	- Process improvement for new	TINA	0.087	0.148	0.200	0.122	

	administrative system or procedure						
	- Process improvement for new production method	TINP	-0.018	0.366	-0.127	-0.182	
	- Process improvement for new marketing or sales approach	TINM	0.006	0.075	0.180	-0.018	
	- Process improvement for new customer support program	TINC	-0.014	-0.141	0.065	-0.071	
	- Process improvement for new logistical approach	TINL	-0.108	-0.014	-0.096	-0.100	
	- Process improvement for new pricing approach	TIPR	-0.054	-0.163	0.163	0.088	
	- Process improvement for new distribution channel or method	TIND	0.036	-0.057	0.136	-0.029	
	- Process improvement for new financing method	TIFM	-0.021	0.155	-0.110	-0.041	
	- Process improvement for new purchasing technique	TIPT	0.014	0.017	-0.199	-0.180	
	- Process improvement for new organisational form or structure	TIOF	0.120	0.123	0.076	0.099	
	Recognition of innovation barriers (IB) (Q31)						
	Financial						
	- Lack of venture capital in early stage of venture	IBVCE	-0.069	-0.025	-0.169	0.044	
	- Lack of public funds in early stage of venture	IBPFE	0.106	0.035	0.049	-0.007	
	- Lack of government research funds in early stage of venture	IBGRE	0.054	0.202	-0.100	0.078	
	- Lack of venture capital in late stage of venture	IBVCL	0.048	0.029	0.070	0.193	
	- Lack of public funds in late stage of venture	IBPFL	0.257	-0.020	-0.022	0.127	
	- Lack of government research funds in late stage of venture	IBGRL	0.009	-0.119	-0.048	-0.070	
	Regulatory						
	- Australian government regulations (eg state or federal)	IBAG	0.166	0.002	-0.034	0.093	
	- Foreign government regulations (eg CE/EMEA approval etc)	IBFG	0.018	0.009	0.079	0.056	
	- Australian patent process	IBAP	-0.048	-0.192	0.322	0.225	
	- Foreign patent process	IBFP	-0.089	-0.278	0.283	0.131	
	- TGA approval process	IBTGA	-0.066	0.120	0.077	0.040	
	- FDA approval process	IBFDA	0.054	-0.010	0.029	-0.158	
	Resource						
	- Lack of skilled managers	IBSM	0.130	0.033	-0.111	-0.073	
	- Lack of skilled researchers	IBSR	-0.106	-0.213	0.031	0.149	
	- Lack of research facilities/assets	IBRF	0.115	0.008	-0.030	0.098	
	- Lack of manufacturing facilities	IBMF	-0.037	0.0.35	-0.014	0.019	
	- Lack of marketing/distribution channels	IBMC	-0.231	0.173	0.259	0.172	
	- Lack of clinical trial facilities	IBCTG	0.020	0.162	0.144	-0.124	

Entrepreneurial Process (EP)	**<u>Presence of opportunity (PO) (Q23)</u>**						
	- In market (eg needs, customers and potential market size)	POIM	-0.180	0.361	-0.029	-0.236	
	- In Economy (eg profits after tax and time to break even etc)	POIE	-0.104	0.218	0.162	0.246	
	- In competitive advantage (eg barrier to entry, and degree of control over costs and prices etc)	POCA	0.069	-0.068	0.060	-0.125	
	- In network/management expertise/risk control	PONR	0.172	0.109	0.147	0.002	
	<u>Opportunity recognition (OR) (Q23)</u>						
	- Changing demographics	ORCD	-0.249	-0.289	0.252	-0.060	
	- Emergence of new market segments	ORNMS	-0.285	-0.119	0.198	-0.189	
	- New process needs	ORNPN	-0.131	-0.002	0.367	0.121	
	- New technologies	ORNT	0.013	0.078	-0.145	0.130	
	- Incongruities/ Lack of harmony	ORILH	-0.109	0.001	**<u>0.563</u>**	0.134	
	- Regulatory change	ORRC	-0.330	0.194	0.253	-0.159	
	- Social change	ORSC	-0.072	-0.029	0.338	-0.188	
	<u>Decision for opportunity exploitation (DOE) (Q23)</u>						
	- New products	DOENP	**<u>0.471</u>**	0.197	0.026	-0.078	
	- New services	DOENS	0.041	**<u>0.503</u>**	-0.104	-0.243	
	- New processes	DOENPC	0.358	0.255	0.029	-0.042	
	- New markets	DOENM	0.082	0.010	0.079	**<u>-0.757</u>**	
	- New organisational structure/forms	DOENOS	-0.008	0.372	0.208	-0.024	
	- New technologies	DOENT	0.010	-0.025	-0.099	-0.051	
	- New sales or distribution channels	DOENSC	-0.060	0.049	**<u>0.437</u>**	-0.173	
	<u>Resource acquisition (RA) (Q23)</u>						
	- Skilled employees	RASE	-0.072	-0.152	0.019	-0.005	
	- General management expertise	RAGME	0.078	-0.091	0.089	0.053	
	- Marketing and sales expertise	RAMSE	0.024	0.080	-0.019	-0.138	
	- Technical expertise	RATE	-0.325	-0.034	-0.169	0.118	
	- Financing	RAF	0.369	0.020	0.105	-0.014	
	- Distribution	RAD	-0.067	0.065	0.095	0.049	
	- Source of supply	RASS	0.108	0.042	-0.226	0.021	
	- Production facilities	RAPF	0.087	-0.254	0.083	0.149	
	- Licences, patents and legal protection	RALP	0.189	-0.110	-0.137	0.173	
	<u>Process management (PM) (Q23)</u>						
	- Absorption of new concept into mainstream operations	PMNC	0.179	0.076	0.095	-0.078	
	- Licensing of rights with other company	PMLR	-0.002	-0.006	0.186	0.042	
	- Calculating the uncertainty of opportunities/risk	PMUO	0.112	0.064	-0.033	-0.009	
	- Company organisation design	PMOR	0.027	0.350	0.085	0.093	
Enhanced organisational achievement (EOA)	**<u>Business model (BM) (Q36)</u>**						
	- Strategic alliance with partners	BMSA	0.379	0.035	0.101	0.009	
	- Refocussed current product development	BMRCP	0.041	0.046	**<u>0.810</u>**	-0.073	
	- Launch new products	BMLNP	0.251	0.058	0.019	0.022	
	- Raised public capital	BMPUC	**<u>0.771</u>**	0.016	-0.042	0.072	
	- Raised private capital	BMPRC	0.002	-0.081	0.155	0.029	
	- Acquisition	BMA	0.66	0.119	0.037	-0.015	
	- Merger	BMM	0.74	0.002	0.112	0.112	
	<u>Enterprise performance (EP) (Q37)</u>						
	- Managerial skills	EPMS	0.194	**<u>0.471</u>**	0.058	0.010	
	- Efficiency/speed of product development	EPEPD	0.072	0.189	0.048	0.254	
	- Skilled labour	EPSL	0.251	-0.119	-0.017	0.139	
	- Quality of product	EPQP	0.054	-0.116	-0.362	-0.091	
	- Marketing capability	EPMC	-0.115	0.167	0.092	0.009	
	- Collaboration with	EPCU	-0.111	0.006	0.089	0.168	

	universities/research centres						
	- Government support	EPGS	0.361	0.146	0.078	-0.095	
	- Collaboration with industrial companies	EPCIC	-0.026	0.121	-0.018	0.064	
	- Access to seed/venture capital	EPASV	-0.030	-0.072	-0.045	0.020	
	- Collaboration with other biotechnology companies	EPCBC	-0.004	0.247	0.069	-0.064	
	- Access to domestic markets	EPDM	0.049	0.344	0.202	0.077	
	- Physical proximity to collaborators	EPPPC	-0.008	0.003	0.001	-0.180	
	- Access to international markets	EPAIM	0.022	<u>**0.808**</u>	0.058	-0.008	
	- Ability to recognise commercial application of technology	EPACA	-0.026	0.112	-0.107	0.002	
	- Learning from end users	EPLEU	0.193	0.065	0.134	-0.097	
	- Technology transfer from suppliers/ inventors	EPTTI	0.087	0.357	-0.312	0.023	
	- Research capability	EPRC	0.304	-0.200	0.131	0.106	
	Eigenvalues		3.407	3.406	3.372	3.331	13.52
	% of variance		2.937	2.937	2.906	2.872	11.65
	Alpha coefficient (α)		0.902	0.901	0.902	0.900	

Note: Factor loadings over 0.40 appear in <u>**bold and underlined**</u>.

APPENDIX I: Summary of exploratory factor analysis for 30 important factors after factor extraction - (5) Environmental Uncertainty (EU) factors for construct measures

Type	Construct measure	Item	Rotated factor loadings					Total
			EUPI	EULI	EURI	EUSI	EUFI	
Entrepreneur (EN)	**Entrepreneurial types (ET) (Q24)**							
	- Personal achiever	ETPA	0.110	-0.040	-0.021	0.193	-0.101	
	- Super' sales people	ETSS	-0.013	0.064	-0.033	0.107	-0.077	
	- Expert idea generator	ETEI	-0.107	-0.180	0.193	-0.047	-0.032	
	- Real manager	ETRM	0.066	0.132	-0.064	-0.155	0.184	
External driver (ED)	**Market orientation (MO) (Q38)**							
	- Identified customer needs	MOIC	0.052	0.067	0.112	-0.050	-0.092	
	- Emerging industry	MOEI	0.312	0.038	-0.013	**-0.400**	-0.115	
	- High market growth rate (eg 30-50%)	MOMR	0.018	0.219	0.231	0.251	0.135	
	- High gross margin (eg 40-50%)	MOGM	0.133	-0.019	-0.053	0.149	0.034	
	- Reasonable market share (eg 20%)	MOMS	0.078	-0.044	**0.831**	0.005	-0.064	
	Business climate (BC) (Q39)							
	- Good profit after tax (eg 10-15%)	BCPT	-0.045	0.061	0.127	-0.032	0.042	
	- Short time to break even and positive cash flow (eg under 2 years)	BCBE	0.134	0.064	0.090	0.393	-0.091	
	- Low to moderate capital requirements	BCCR	0.153	-0.175	-0.002	0.257	0.041	
	Competitive advantages (CA) (Q40)							
	- Low fixed and variable costs for production/marketing/distribution	CAFC	0.048	0.009	-0.002	**0.887**	-0.045	
	- Moderate to strong degree of control for prices/costs/channels of supply etc	CACP	-0.057	-0.039	-0.067	0.255	0.033	
	- Barriers to entry for proprietary protection/lead time/legal advantage	CABE	0.070	-0.077	**0.436**	0.003	0.091	
	- Product differentiation	CAPD	-0.064	0.163	0.053	-0.152	0.024	
	Environmental uncertainty (EU) (Q41)							
	- Political infrastructure in society	EUPI	-0.005	0.004	-0.106	0.082	0.014	
	- Legal infrastructure	EULI	-0.052	0.114	0.077	-0.032	0.199	
	- Regulatory infrastructure	EURI	0.054	-0.031	-0.030	-0.056	0.017	
	- Socio-cultural infrastructure	EUSI	0.026	-0.057	0.029	0.317	0.255	
	- Financial infrastructure	EUFI	0.003	-0.025	0.019	0.172	0.097	
Organisational driver (OD)	**Organisational strategy (OO) (Q42)**							
	- Logistical infrastructure	OOLI	0.275	0.070	0.100	0.039	-0.129	
	- Within-company infrastructure	OOCI	0.049	0.051	0.099	-0.049	0.060	
	- Networks/contacts	OONC	0.086	-0.151	0.094	-0.041	0.227	
	- Management team expertise	OOMT	-0.191	-0.117	0.276	0.126	0.011	
	- Risk control	OORC	0.051	-0.026	0.132	0.160	0.175	
Entrepreneurial leadership capacity (ELC)	**Types of innovation (TI) (Q28)**							
	- New to the world product or service	TINW	-0.007	-0.092	-0.048	-0.156	0.092	
	- New to the firm product or service in line that at least one competitor is offering	TIFP	-0.099	0.171	-0.057	-0.087	0.308	
	- New to the country and/or market product or service	TICM	0.001	-0.150	0.176	0.023	-0.167	
	- New application of existing product or service, including application to a new market segment	TIEP	-0.290	0.129	-0.062	**0.436**	-0.197	
	- Addition to a company's existing product or service line	TIAP	0.013	-0.149	0.113	-0.009	-0.065	
	- Repositioning of an existing product or service	TIRP	-0.299	-0.104	0.034	0.107	-0.153	
	- Product/service improvement, revision, including application of new feature or option or change	TIPS	0.206	0.045	-0.125	-0.042	0.092	
	- Process improvement for new	TINA	0.113	-0.041	0.290	-0.021	0.046	

	administrative system or procedure							
	- Process improvement for new production method	TINP	0.011	-0.094	-0.074	0.215	0.204	
	- Process improvement for new marketing or sales approach	TINM	-0.139	-0.072	-0.028	-0.131	-0.054	
	- Process improvement for new customer support program	TINC	0.084	0.070	-0.094	-0.045	-0.066	
	- Process improvement for new logistical approach	TINL	0.020	0.012	0.068	0.098	0.138	
	- Process improvement for new pricing approach	TIPR	0.085	0.180	0.039	-0.053	0.106	
	- Process improvement for new distribution channel or method	TIND	-0.313	0.083	0.024	-0.040	-0.152	
	- Process improvement for new financing method	TIFM	-0.004	-0.157	0.090	0.105	0.092	
	- Process improvement for new purchasing technique	TIPT	-0.048	-0.111	0.001	-0.009	-0.054	
	- Process improvement for new organisational form or structure	TIOF	-0.008	-0.098	0.279	-0.004	0.162	
	Recognition of innovation barriers (IB) (Q31)							
	Financial							
	- Lack of venture capital in early stage of venture	IBVCE	0.079	0.275	-0.042	0.050	-0.049	
	- Lack of public funds in early stage of venture	IBPFE	0.102	0.047	0.221	0.027	0.089	
	- Lack of government research funds in early stage of venture	IBGRE	-0.249	0.000	0.096	0.075	0.051	
	- Lack of venture capital in late stage of venture	IBVCL	0.048	0.097	-0.272	0.082	-0.260	
	- Lack of public funds in late stage of venture	IBPFL	0.071	0.177	-0.168	-0.086	0.212	
	- Lack of government research funds in late stage of venture	IBGRL	-0.075	-0.074	0.116	-0.038	-0.133	
	Regulatory							
	- Australian government regulations (eg state or federal)	IBAG	-0.149	0.091	-0.011	-0.035	0.026	
	- Foreign government regulations (eg CE/EMEA approval etc)	IBFG	-0.024	0.062	-0.111	0.028	-0.112	
	- Australian patent process	IBAP	-0.165	-0.032	0.397	-0.148	0.035	
	- Foreign patent process	IBFP	-0.199	0.049	0.255	-0.173	0.051	
	- TGA approval process	IBTGA	0.061	0.019	0.080	0.065	0.138	
	- FDA approval process	IBFDA	-0.043	-0.011	0.090	-0.068	-0.100	
	Resource							
	- Lack of skilled managers	IBSM	-0.057	**0.828**	-0.086	0.027	-0.058	
	- Lack of skilled researchers	IBSR	-0.176	0.335	0.244	-0.078	-0.159	
	- Lack of research facilities/assets	IBRF	-0.124	0.243	0.055	-0.013	-0.012	
	- Lack of manufacturing facilities	IBMF	0.112	0.072	-0.001	-0.014	-0.105	
	- Lack of marketing/distribution channels	IBMC	0.031	**0.451**	0.203	-0.022	-0.212	
	- Lack of clinical trial facilities	IBCTG	-0.158	0.187	0.270	-0.396	-0.077	

Entrepreneurial Process (EP)	**Presence of opportunity (PO) (Q23)**							
	- In market (eg needs, customers and potential market size)	POIM	0.248	0.020	0.067	0.115	-0.162	
	- In Economy (eg profits after tax and time to break even etc)	POIE	0.018	-0.124	0.181	-0.165	-0.061	
	- In competitive advantage (eg barrier to entry, and degree of control over costs and prices etc)	POCA	0.203	-0.041	0.094	-0.056	0.119	
	- In network/management expertise/risk control	PONR	**0.579**	-0.225	-0.022	-0.091	0.140	
	Opportunity recognition (OR) (Q23)							
	- Changing demographics	ORCD	0.131	-0.080	-0.073	-0.032	0.032	
	- Emergence of new market segments	ORNMS	0.003	-0.030	-0.271	0.020	0.21	
	- New process needs	ORNPN	0.175	-0.035	-0.021	-0.063	-0.119	
	- New technologies	ORNT	-0.103	0.060	-0.073	0.254	0.000	
	- Incongruities/ Lack of harmony	ORILH	0.142	0.250	0.186	0.018	0.317	
	- Regulatory change	ORRC	-0.041	0.052	-0.014	0.094	0.378	
	- Social change	ORSC	0.161	-0.191	0.101	0.106	0.254	
	Decision for opportunity exploitation (DOE) (Q23)							
	- New products	DOENP	-0.127	-0.215	0.130	-0.047	0.025	
	- New services	DOENS	-0.239	0.184	0.068	0.317	-0.029	
	- New processes	DOENPC	-0.090	0.165	-0.086	0.165	-0.130	
	- New markets	DOENM	0.121	0.002	-0.095	0.111	0.257	
	- New organisational structure/forms	DOENOS	-0.203	0.090	0.268	-0.240	0.215	
	- New technologies	DOENT	0.044	-0.236	0.313	-0.069	-0.024	
	- New sales or distribution channels	DOENSC	-0.248	0.056	0.136	-0.093	0.127	
	Resource acquisition (RA) (Q23)							
	- Skilled employees	RASE	0.195	0.199	-0.091	0.073	0.001	
	- General management expertise	RAGME	0.103	0.328	0.150	-0.127	-0.056	
	- Marketing and sales expertise	RAMSE	-0.002	0.023	-0.007	-0.075	-0.040	
	- Technical expertise	RATE	0.215	0.136	0.306	-0.182	-0.067	
	- Financing	RAF	0.121	0.207	0.121	-0.014	0.238	
	- Distribution	RAD	-0.056	-0.109	-0.068	0.064	0.068	
	- Source of supply	RASS	0.161	-0.102	0.269	-0.008	0.075	
	- Production facilities	RAPF	0.334	-0.223	-0.069	0.061	0.118	
	- Licences, patents and legal protection	RALP	0.047	0.131	0.057	-0.031	0.134	
	Process management (PM) (Q23)							
	- Absorption of new concept into mainstream operations	PMNC	0.105	0.085	-0.020	0.054	-0.025	
	- Licensing of rights with other company	PMLR	-0.143	-0.033	0.028	-0.145	**0.494**	
	- Calculating the uncertainty of opportunities/risk	PMUO	0.066	-0.084	-0.053	-0.023	**0.877**	
	- Company organisation design	PMOR	-0.063	0.027	0.025	-0.133	0.180	
Enhanced organisational achievement (EOA)	**Business model (BM) (Q36)**							
	- Strategic alliance with partners	BMSA	0.051	0.255	0.195	0.227	0.160	
	- Refocussed current product development	BMRCP	-0.095	-0.141	-0.075	-0.036	-0.036	
	- Launch new products	BMLNP	-0.133	**-0.420**	0.118	0.044	-0.133	
	- Raised public capital	BMPUC	0.007	0.090	0.071	-0.095	0.133	
	- Raised private capital	BMPRC	0.023	-0.019	0.037	0.147	-0.047	
	- Acquisition	BMA	0.053	-0.202	0.077	-0.008	0.051	
	- Merger	BMM	0.003	0.037	0.076 3	-0.035	-0.117	
	Enterprise performance (EP) (Q37)							
	- Managerial skills	EPMS	0.024	0.283		-0.157	0.140	
	- Efficiency/speed of product development	EPEPD	-0.219	-0.135	-0.002 -0.046	0.036	0.003	
	- Skilled labour	EPSL	-0.063	-0.036		-0.077	0.023	
	- Quality of product	EPQP	-0.059	-0.087	0.018	-0.178	0.163	
	- Marketing capability	EPMC	-0.071	0.107	-0.034	0.044	-0.109	
	- Collaboration with	EPCU	0.020	0.097	-0.010	-0.091	0.068	

	universities/research centres				0.180			
	- Government support	EPGS	-0.012	-0.022		0.002	0.053	
	- Collaboration with industrial	EPCIC	0.013	0.237	-0.092	0.260	-0.062	
	companies				-0.156			
	- Access to seed/venture capital	EPASV	0.007	-0.063		-0.089	-0.129	
	- Collaboration with other	EPCBC	0.154	0.014	0.077	0.255	0.162	
	biotechnology companies				-0.270			
	- Access to domestic markets	EPDM	-0.124	-0.361		0.123	0.153	
	- Physical proximity to collaborators	EPPPC	0.365	0.080	-0.146	0.203	-0.125	
	- Access to international markets	EPAIM	0.243	-0.052	0.148	0.063	0.032	
	- Ability to recognise commercial	EPACA	**<u>0.932</u>**	0.022	0.061	0.027	0.011	
	application of technology				0.063			
	- Learning from end users	EPLEU	0.199	0.052		-0.083	-0.155	
	- Technology transfer from suppliers/	EPTTI	0.166	-0.368	-0.139	-0.202	0.117	
	inventors				0.037			
	- Research capability	EPRC	-0.015	0.224		0.060	0.059	
					<u>0.407</u>			
	Eigenvalues		3.286	3.207	3.127	3.066	2.928	15.61
	% of variance		2.833	2.764	2.696	2.643	2.524	13.46
	Alpha coefficient (α)		0.900	0.900	0.900	0.901	0.901	

Note: Factor loadings over 0.40 appear in **<u>bold and underlined</u>**.

APPENDIX J: Summary of exploratory factor analysis for 30 important factors after factor extraction - (6) Organisational Strategy (OO) factors for construct measures

Type	Construct measure	Item	Rotated factor loadings					Total
			OOLI	OOCI	OONC	OOMT	OORC	
Entrepreneur (EN)	**Entrepreneurial types (ET) (Q24)**							
	- Personal achiever	ETPA	0.143	0.133	0.066	-0.098	-0.016	
	- Super' sales people	ETSS	0.114	-0.095	-0.147	**-0.840**	0.142	
	- Expert idea generator	ETEI	0.077	-0.010	0.079	-0.136	0.138	
	- Real manager	ETRM	0.293	-0.049	-0.097	0.009	-0.024	
External driver (ED)	**Market orientation (MO) (Q38)**							
	- Identified customer needs	MOIC	-0.070	0.016	0.050	-0.026	0.103	
	- Emerging industry	MOEI	0.109	-0.194	0.018	0.086	0.128	
	- High market growth rate (eg 30-50%)	MOMR	-0.349	-0.097	0.131	0.144	0.014	
	- High gross margin (eg 40-50%)	MOGM	-0.017	0.207	0.091	0.113	0.267	
	- Reasonable market share (eg 20%)	MOMS	-0.033	-0.003	0.154	0.024	-0.047	
	Business climate (BC) (Q39)							
	- Good profit after tax (eg 10-15%)	BCPT	0.274	-0.078	0.018	-0.112	0.212	
	- Short time to break even and positive cash flow (eg under 2 years)	BCBE	0.117	-0.047	-0.058	-0.174	-0.074	
	- Low to moderate capital requirements	BCCR	0.002	-0.004	0.097	0.028	0.060	
	Competitive advantages (CA) (Q40)							
	- Low fixed and variable costs for production/marketing/distribution	CAFC	-0.059	-0.034	0.066	-0.108	0.008	
	- Moderate to strong degree of control for prices/costs/channels of supply etc	CACP	0.019	0.125	0.085	0.081	0.031	
	- Barriers to entry for proprietary protection/lead time/legal advantage	CABE	0.044	-0.027	-0.096	0.246	-0.066	
	- Product differentiation	CAPD	0.169	0.156	-0.051	-0.053	0.098	
	Environmental uncertainty (EU) (Q41)							
	- Political infrastructure in society	EUPI	0.125	-0.059	0.081	0.065	0.026	
	- Legal infrastructure	EULI	0.059	0.031	00.42	0.089	-0.129	
	- Regulatory infrastructure	EURI	-0.104	-0.047	0.062	0.034	-0.047	
	- Socio-cultural infrastructure	EUSI	0.097	0.017	0.043	0.069	-0.197	
	- Financial infrastructure	EUFI	0.092	0.082	-0.078	0.018	**-0.609**	
Organisational driver (OD)	**Organisational strategy (OO) (Q42)**							
	- Logistical infrastructure	OOLI	-0.064	-0.072	0.269	-0.047	-0.085	
	- Within-company infrastructure	OOCI	-0.130	0.106	0.187	0.067	-0.148	
	- Networks/contacts	OONC	-0.153	0.206	-0.001	0.106	-0.207	
	- Management team expertise	OOMT	-0.067	**0.652**	0.135	0.121	-0.090	
	- Risk control	OORC	-0.257	-0.108	0.214	0.152	0.134	
Entrepreneurial leadership capacity (ELC)	**Types of innovation (TI) (Q28)**							
	- New to the world product or service	TINW	0.084	0.023	-0.111	**0.402**	-0.010	
	- New to the firm product or service in line that at least one competitor is offering	TIFP	-0.189	0.251	-0.070	0.141	0.174	
	- New to the country and/or market product or service	TICM	-0.069	0.128	0.070	-0.088	0.141	
	- New application of existing product or service, including application to a new market segment	TIEP	0.076	0.310	-0.135	0.094	0.153	
	- Addition to a company's existing product or service line	TIAP	0.030	0.152	0.031	-0.127	-0.41	
	- Repositioning of an existing product or service	TIRP	0.273	0.308	0.050	0.042	0.091	
	- Product/service improvement, revision, including application of new feature or option or change	TIPS	-0.055	**0.830**	0.013	0.029	0.052	
	- Process improvement for new	TINA	0.059	-0.008	0.050	-0.152	0.191	

	administrative system or procedure							
	- Process improvement for new production method	TINP	-0.036	0.238	-0.006	-0.166	-0.062	
	- Process improvement for new marketing or sales approach	TINM	0.225	0.046	0.004	-0.015	0.044	
	- Process improvement for new customer support program	TINC	0.057	-0.027	-0.040	0.038	-0.070	
	- Process improvement for new logistical approach	TINL	-0.185	-0.009	0.187	-0.022	-0.114	
	- Process improvement for new pricing approach	TIPR	0.007	-0.009	0.117	0.106	0.054	
	- Process improvement for new distribution channel or method	TIND	0.132	0.082	-0.023	-0.051	-0.127	
	- Process improvement for new financing method	TIFM	-0.062	0.009	0.204	0.049	-0.079	
	- Process improvement for new purchasing technique	TIPT	-0.238	0.183	0.006	0.170	-0.106	
	- Process improvement for new organisational form or structure	TIOF	0.013	0.078	0.039	-0.110	0.211	
	Recognition of innovation barriers (IB) (Q31)							
	Financial							
	- Lack of venture capital in early stage of venture	IBVCE	0.181	0.106	**0.647**	0.051	-0.027	
	- Lack of public funds in early stage of venture	IBPFE	-0.032	0.063	**0.826**	0.156	-0.018	
	- Lack of government research funds in early stage of venture	IBGRE	0.141	-0.182	**0.455**	-0.156	0.163	
	- Lack of venture capital in late stage of venture	IBVCL	0.025	0.080	0.272	-0.221	-0.296	
	- Lack of public funds in late stage of venture	IBPFL	0.000	0.324	0.140	-0.002	0.043	
	- Lack of government research funds in late stage of venture	IBGRL	0.013	-0.056	0.034	0.131	-0.115	
	Regulatory							
	- Australian government regulations (eg state or federal)	IBAG	-0.008	-0.023	-0.125	-0.150	0.139	
	- Foreign government regulations (eg CE/EMEA approval etc)	IBFG	0.103	0.016	0.062	-0.061	0.017	
	- Australian patent process	IBAP	0.180	-0.001	0.072	-0.083	-0.008	
	- Foreign patent process	IBFP	0.229	0.003	0.117	-0.143	-0.019	
	- TGA approval process	IBTGA	-0.020	-0.013	-0.066	0.138	0.045	
	- FDA approval process	IBFDA	0.017	-0.012	-0.027	-0.003	-0.025	
	Resource							
	- Lack of skilled managers	IBSM	0.126	-0.039	0.186	-0.124	0.081	
	- Lack of skilled researchers	IBSR	0.016	-0.069	0.145	0.208	0.177	
	- Lack of research facilities/assets	IBRF	0.012	-0.016	0.133	0.298	0.073	
	- Lack of manufacturing facilities	IBMF	0.060	-0.104	0.061	-0.218	0.033	
	- Lack of marketing/distribution channels	IBMC	-0.156	0.198	-0.221	0.056	0.081	
	- Lack of clinical trial facilities	IBCTG	-0.155	-0.091	-0.021	0.025	-0.016	

Entrepreneurial Process (EP)	**Presence of opportunity (PO) (Q23)**							
	- In market (eg needs, customers and potential market size)	POIM	0.204	0.199	-0.211	-0.064	0.053	
	- In Economy (eg profits after tax and time to break even etc)	POIE	0.087	0.075	-0.058	0.136	-0.008	
	- In competitive advantage (eg barrier to entry, and degree of control over costs and prices etc)	POCA	0.123	-0.192	-0.001	0.050	-0.104	
	- In network/management expertise/risk control	PONR	0.037	0.142	-0.031	0.061	-0.010	
	Opportunity recognition (OR) (Q23)							
	- Changing demographics	ORCD	0.007	0.084	0.009	-0.102	0.057	
	- Emergence of new market segments	ORNMS	0.008	0.292	0.042	-0.041	0.043	
	- New process needs	ORNPN	0.091	-0.063	0.076	0.181	0.146	
	- New technologies	ORNT	0.041	-0.183	-0.037	0.081	-0.009	
	- Incongruities/ Lack of harmony	ORILH	0.075	0.135	0.027	0.228	-0.078	
	- Regulatory change	ORRC	0.061	0.038	0.104	0.128	-0.009	
	- Social change	ORSC	0.024	0.068	-0.012	-0.170	-0.282	
	Decision for opportunity exploitation (DOE) (Q23)							
	- New products	DOENP	0.055	-0.091	0.166	-0.127	0.013	
	- New services	DOENS	0.068	0.159	0.246	-0.241	0.055	
	- New processes	DOENPC	-0.036	0.090	0.014	-0.070	0.181	
	- New markets	DOENM	-0.103	0.069	0.071	-0.022	0.122	
	- New organisational structure/forms	DOENOS	0.121	-0.237	-0.092	0.012	0.185	
	- New technologies	DOENT	0.019	0.152	0.042	0.067	0.045	
	- New sales or distribution channels	DOENSC	-0.024	0.196	0.108	-0.056	0.062	
	Resource acquisition (RA) (Q23)							
	- Skilled employees	RASE	0.049	-0.059	-0.011	0.198	0.077	
	- General management expertise	RAGME	0.180	-0.143	0.093	0.090	0.114	
	- Marketing and sales expertise	RAMSE	0.014	-0.016	-0.026	-0.101	0.172	
	- Technical expertise	RATE	0.056	0.007	0.297	-0.158	0.390	
	- Financing	RAF	0.197	-0.167	0.223	-0.046	-0.110	
	- Distribution	RAD	0.040	0.002	0.119	-0.141	-0.018	
	- Source of supply	RASS	-0.203	-0.232	0.175	0.145	0.134	
	- Production facilities	RAPF	0.106	-0.064	-0.128	0.321	0.136	
	- Licences, patents and legal protection	RALP	0.048	-0.007	-0.013	-0.137	0.127	
	Process management (PM) (Q23)							
	- Absorption of new concept into mainstream operations	PMNC	**0.825**	-0.087	0.085	-0.131	-0.077	
	- Licensing of rights with other company	PMLR	**0.523**	-0.110	0.060	0.191	0.034	
	- Calculating the uncertainty of opportunities/risk	PMUO	0.003	0.082	0.040	0.030	0.048	
	- Company organisation design	PMOR	0.119	-0.046	-0.129	0.134	0.027	
Enhanced organisational achievement (EOA)	**Business model (BM) (Q36)**							
	- Strategic alliance with partners	BMSA	0.097	0.092	0.031	-0.083	0.075	
	- Refocussed current product development	BMRCP	0.093	-0.086	-0.095	-0.026	0.096	
	- Launch new products	BMLNP	0.182	-0.067	0.212	-0.239	0.379	
	- Raised public capital	BMPUC	0.126	-0.063	0.007	0.172	0.011	
	- Raised private capital	BMPRC	-0.061	0.020	0.098	-0.054	-0.174	
	- Acquisition	BMA	0.065	-0.029	-0.036	-0.060	-0.073	
	- Merger	BMM	0.025	0.000	0.014	0.063	-0.092	
	Enterprise performance (EP) (Q37)							
	- Managerial skills	EPMS	**0.420**	0.047	-0.053	-0.062	-0.134	
	- Efficiency/speed of product development	EPEPD	0.054	0.043	0.060	-0.026	-0.035	
	- Skilled labour	EPSL	-0.039	0.002	0.023	-0.002	0.090	
	- Quality of product	EPQP	0.330	0.064	-0.016	-0.271	0.011	
	- Marketing capability	EPMC	0.252	0.008	0.088	0.021	0.182	
	- Collaboration with	EPCU	-0.003	-0.121	0.005	0.053	-0.085	

	universities/research centres							
	- Government support	EPGS	0.109	0.017	0.215	-0.336	-0.167	
	- Collaboration with industrial companies	EPCIC	0.083	0.101	-0.030	0.048	0.209	
	- Access to seed/venture capital	EPASV	0.060	-0.074	0.077	0.117	**<u>-0.827</u>**	
	- Collaboration with other biotechnology companies	EPCBC	-0.140	-0.082	-0.033	-0.087	0.043	
	- Access to domestic markets	EPDM	0.066	-0.208	-0.048	0.050	0.049	
	- Physical proximity to collaborators	EPPPC	-0.085	0.034	-0.071	0.116	0.005	
	- Access to international markets	EPAIM	0.007	0.042	0.064	0.123	0.013	
	- Ability to recognise commercial application of technology	EPACA	0.046	0.060	0.098	-0.013	-0.010	
	- Learning from end users	EPLEU	0.047	0.052	-0.218	0.217	-0.066	
	- Technology transfer from suppliers/ inventors	EPTTI	0.325	0.241	-0.156	-0.010	0.074	
	- Research capability	EPRC	-0.048	-0.312	0.269	-0.211	-0.129	
	Eigenvalues		2.888	2.835	2.756	2.720	2.716	13.92
	% of variance		2.489	2.444	2.376	2.345	2.341	12.00
	Alpha coefficient (α)		0.901	0.901	0.901	0.901	0.902	

Note: Factor loadings over 0.40 appear in **<u>bold and underlined</u>**.

APPENDIX K: Summary of exploratory factor analysis for 30 important factors after factor extraction - (7) Types of Innovation (TI) factors for construct measures

Type	Construct measure	Item	Rotated factor loadings				Total
			TINW	TIFP	TICM	TIEP	
Entrepreneur (EN)	**Entrepreneurial types (ET) (Q24)**						
	- Personal achiever	ETPA	-0.166	0.112	0.284	0.202	
	- Super' sales people	ETSS	-0.090	-0.049	0.067	0.094	
	- Expert idea generator	ETEI	0.041	-0.002	0.116	0.028	
	- Real manager	ETRM	-0.081	0.059	0.025	0.051	
External driver (ED)	**Market orientation (MO) (Q38)**						
	- Identified customer needs	MOIC	0.161	0.093	0.051	0.105	
	- Emerging industry	MOEI	0.112	-0.023	-0.212	-0.150	
	- High market growth rate (eg 30-50%)	MOMR	-0.172	-0.105	-0.290	-0.058	
	- High gross margin (eg 40-50%)	MOGM	0.030	0.322	-0.014	-0.108	
	- Reasonable market share (eg 20%)	MOMS	0.010	-0.045	0.005	0.076	
	Business climate (BC) (Q39)						
	- Good profit after tax (eg 10-15%)	BCPT	0.305	0.116	-0.327	-0.194	
	- Short time to break even and positive cash flow (eg under 2 years)	BCBE	-0.026	-0.119	0.012	0.005	
	- Low to moderate capital requirements	BCCR	0.082	0.133	0.114	0.156	
	Competitive advantages (CA) (Q40)						
	- Low fixed and variable costs for production/marketing/distribution	CAFC	0.159	-0.054	0.124	-0.043	
	- Moderate to strong degree of control for prices/costs/channels of supply etc	CACP	**0.737**	0.075	-0.003	0.133	
	- Barriers to entry for proprietary protection/lead time/legal advantage	CABE	-0.032	**0.404**	-0.030	0.150	
	- Product differentiation	CAPD	0.154	0.047	0.137	0.199	
	Environmental uncertainty (EU) (Q41)						
	- Political infrastructure in society	EUPI	0.083	0.220	-0.031	0.073	
	- Legal infrastructure	EULI	0.042	0.083	-0.077	-0.117	
	- Regulatory infrastructure	EURI	0.177	**0.786**	0.154	0.021	
	- Socio-cultural infrastructure	EUSI	0.178	-0.071	-0.243	0.043	
	- Financial infrastructure	EUFI	0.228	-0.002	-0.004	-0.244	
Organisational driver (OD)	**Organisational strategy (OO) (Q42)**						
	- Logistical infrastructure	OOLI	0.248	0.272	0.048	0.060	
	- Within-company infrastructure	OOCI	**0.600**	0.225	-0.013	0.059	
	- Networks/contacts	OONC	0.281	-0.044	0.258	0.50	
	- Management team expertise	OOMT	0.156	0.099	0.214	-0.021	
	- Risk control	OORC	0.309	0.186	-0.159	-0.060	
Entrepreneurial leadership capacity (ELC)	**Types of innovation (TI) (Q28)**						
	- New to the world product or service	TINW	-0.051	0.102	0.301	-0.058	
	- New to the firm product or service in line that at least one competitor is offering	TIFP	-0.318	0.287	-0.015	0.142	
	- New to the country and/or market product or service	TICM	0.015	0.240	0.085	0.051	
	- New application of existing product or service, including application to a new market segment	TIEP	-0.032	0.241	-0.039	0.102	
	- Addition to a company's existing product or service line	TIAP	0.103	0.044	0.031	**0.782**	
	- Repositioning of an existing product or service	TIRP	-0.009	0.152	0.016	0.092	
	- Product/service improvement, revision, including application of new feature or option or change	TIPS	0.040	-0.085	-0.032	0.145	
	- Process improvement for new	TINA	0.196	-0.055	0.167	0.023	

	administrative system or procedure						
	- Process improvement for new production method	TINP	-0.007	0.047	0.180	-0.218	
	- Process improvement for new marketing or sales approach	TINM	0.103	0.057	-0.078	0.170	
	- Process improvement for new customer support program	TINC	-0.109	0.145	-0.222	-0.028	
	- Process improvement for new logistical approach	TINL	-0.158	-0.135	0.050	0.030	
	- Process improvement for new pricing approach	TIPR	-0.099	-0.096	0.147	0.032	
	- Process improvement for new distribution channel or method	TIND	0.036	0.079	0.040	0.136	
	- Process improvement for new financing method	TIFM	0.165	0.050	0.121	-0.123	
	- Process improvement for new purchasing technique	TIPT	-0.149	-0.046	0.047	0.038	
	- Process improvement for new organisational form or structure	TIOF	0.125	-0.032	-0.030	0.141	
	Recognition of innovation barriers (IB) (Q31)						
	Financial						
	- Lack of venture capital in early stage of venture	IBVCE	0.046	0.016	0.342	-0.091	
	- Lack of public funds in early stage of venture	IBPFE	0.103	0.042	-0.030	0.035	
	- Lack of government research funds in early stage of venture	IBGRE	0.151	0.015	0.019	0.111	
	- Lack of venture capital in late stage of venture	IBVCL	-0.166	-0.032	-0.002	0.097	
	- Lack of public funds in late stage of venture	IBPFL	0.196	0.002	0.009	0.158	
	- Lack of government research funds in late stage of venture	IBGRL	0.058	0.118	0.030	-0.008	
	Regulatory						
	- Australian government regulations (eg state or federal)	IBAG	0.042	0.013	-0.050	-0.100	
	- Foreign government regulations (eg CE/EMEA approval etc)	IBFG	-0.053	0.042	-0.096	0.023	
	- Australian patent process	IBAP	0.094	0.070	-0.050	-0.167	
	- Foreign patent process	IBFP	0.093	0.301	-0.085	0.083	
	- TGA approval process	IBTGA	-0.007	-0.066	0.055	-0.099	
	- FDA approval process	IBFDA	-0.014	0.055	0.122	0.130	
	Resource						
	- Lack of skilled managers	IBSM	-0.020	0.026	-0.031	-0.113	
	- Lack of skilled researchers	IBSR	0.010	-0.201	-0.025	-0.091	
	- Lack of research facilities/assets	IBRF	-0.059	-0.049	-0.066	-0.048	
	- Lack of manufacturing facilities	IBMF	-0.023	0.061	-0.078	-0.017	
	- Lack of marketing/distribution channels	IBMC	-0.058	-0.192	-0.031	0.197	
	- Lack of clinical trial facilities	IBCTG	0.021	0.021	-0.123	0.033	

Entrepreneurial Process (EP)	**Presence of opportunity (PO) (Q23)**						
	- In market (eg needs, customers and potential market size)	POIM	-0.006	-0.126	-0.241	-0.081	
	- In Economy (eg profits after tax and time to break even etc)	POIE	0.290	-0.170	0.256	0.008	
	- In competitive advantage (eg barrier to entry, and degree of control over costs and prices etc)	POCA	0.116	-0.003	0.133	-0.061	
	- In network/management expertise/risk control	PONR	0.073	0.089	0.000	0.018	
	Opportunity recognition (OR) (Q23)						
	- Changing demographics	ORCD	0.125	-0.215	0.042	0.232	
	- Emergence of new market segments	ORNMS	-0.044	-0.172	-0.092	0.061	
	- New process needs	ORNPN	-0.061	0.321	0.139	-0.167	
	- New technologies	ORNT	-0.220	-0.040	0.042	**-0.432**	
	- Incongruities/ Lack of harmony	ORILH	-0.012	-0.051	0.143	-0.065	
	- Regulatory change	ORRC	-0.056	0.164	-0.123	-0.180	
	- Social change	ORSC	0.027	0.021	0.079	0.165	
	Decision for opportunity exploitation (DOE) (Q23)						
	- New products	DOENP	0.120	-0.045	-0.015	0.106	
	- New services	DOENS	-0.121	-0.073	-0.049	-0.162	
	- New processes	DOENPC	-0.283	0.269	0.022	-0.267	
	- New markets	DOENM	-0.075	0.047	-0.025	0.041	
	- New organisational structure/forms	DOENOS	-0.051	0.017	0.033	0.204	
	- New technologies	DOENT	-0.033	0.285	0.150	0.029	
	- New sales or distribution channels	DOENSC	-0.188	-0.023	0.077	0.046	
	Resource acquisition (RA) (Q23)						
	- Skilled employees	RASE	0.073	0.130	-0.025	0.026	
	- General management expertise	RAGME	-0.019	-0.039	-0.382	-0.220	
	- Marketing and sales expertise	RAMSE	0.011	0.025	-0.012	0.096	
	- Technical expertise	RATE	-0.029	-0.059	-0.048	0.190	
	- Financing	RAF	0.166	0.101	-0.149	0.013	
	- Distribution	RAD	0.041	0.002	-0.010	-0.120	
	- Source of supply	RASS	0.310	0.226	0.193	0.041	
	- Production facilities	RAPF	0.152	0.159	-0.045	0.028	
	- Licences, patents and legal protection	RALP	-0.058	0.306	-0.145	0.279	
	Process management (PM) (Q23)						
	- Absorption of new concept into mainstream operations	PMNC	-0.012	-0.137	-0.064	0.003	
	- Licensing of rights with other company	PMLR	-0.109	0.061	0.039	0.136	
	- Calculating the uncertainty of opportunities/risk	PMUO	0.069	-0.010	-0.048	-0.063	
	- Company organisation design	PMOR	0.125	-0.262	-0.034	0.130	
Enhanced organisational achievement (EOA)	**Business model (BM) (Q36)**						
	- Strategic alliance with partners	BMSA	0.183	-0.289	-0.044	0.090	
	- Refocussed current product development	BMRCP	0.049	-0.075	0.056	0.115	
	- Launch new products	BMLNP	0.100	0.194	0.065	0.023	
	- Raised public capital	BMPUC	-0.051	0.060	-0.062	-0.056	
	- Raised private capital	BMPRC	-0.001	0.112	**0.858**	0.008	
	- Acquisition	BMA	0.012	-0.036	0.068	0.062	
	- Merger	BMM	0.114	0.030	-0.188	0.000	
	Enterprise performance (EP) (Q37)						
	- Managerial skills	EPMS	0.059	0.136	-0.137	-0.168	
	- Efficiency/speed of product development	EPEPD	0.079	-0.024	-0.005	-0.139	
	- Skilled labour	EPSL	0.063	-0.073	0.041	0.094	
	- Quality of product	EPQP	-0.007	0.013	-0.077	-0.186	
	- Marketing capability	EPMC	-0.185	-0.030	-0.018	0.037	
	- Collaboration with	EPCU	-0.022	-0.062	0.162	-0.151	

	universities/research centres						
	- Government support	EPGS	0.004	0.073	-0.117	0.126	
	- Collaboration with industrial companies	EPCIC	0.154	0.013	-0.116	0.035	
	- Access to seed/venture capital	EPASV	-0.041	0.034	0.236	0.124	
	- Collaboration with other biotechnology companies	EPCBC	0.091	0.009	0.011	0.198	
	- Access to domestic markets	EPDM	0.132	-0.024	0.014	0.317	
	- Physical proximity to collaborators	EPPPC	-0.024	-0.055	0.222	0.369	
	- Access to international markets	EPAIM	-0.132	-0.004	-0.026	-0.073	
	- Ability to recognise commercial application of technology	EPACA	-0.027	0.028	0.018	0.030	
	- Learning from end users	EPLEU	-0.038	0.123	0.246	0.204	
	- Technology transfer from suppliers/ inventors	EPTTI	-0.167	0.006	-0.255	0.063	
	- Research capability	EPRC	-0.107	0.102	0.053	0.105	
	Eigenvalues		2.706	2.661	2.658	2.594	10.62
	% of variance		2.333	2.294	2.291	2.236	9.15
	Alpha coefficient (α)		0.901	0.900	0.901	0.899	

Note: Factor loadings over 0.40 appear in **<u>bold and underlined</u>**.

APPENDIX L: Summary of initial loadings and weights for constructs and indicators

Constructs and indicators	Type	Item/Code	Weight	Loading
<u>Entrepreneurial types (ET) (Q24)</u>	F			
- Personal achiever		ETPA	0.24	0.41
- Super' sales people		ETSS	0.0	-0.01
- Expert idea generator		ETEI	0.33	0.53
- Real manager		ETRM	0.8	0.91
<u>Market orientation (MO) (Q38)</u>	F			
- Identified customer needs		MOIC	0.19	0.24
- Emerging industry		MOEI	0.28	0.28
- High market growth rate (eg 30-50%)		MOMR	0.48	0.52
- High gross margin (eg 40-50%)		MOGM	-0.47	-0.33
- Reasonable market share (eg 20%)		MOMS	0.61	0.78
<u>Business climate (BC) (Q39)</u>	F			
- Good profit after tax (eg 10-15%)		BCPT	0.21	0.08
- Short time to break even and positive cash flow (eg under 2 years)		BCBE	0.47	0.64
- Low to moderate capital requirements		BCCR	0.8	0.85
<u>Competitive advantages (CA) (Q40)</u>	F			
- Low fixed and variable costs for production/marketing/distribution		CAFC	-0.39	-0.37
- Moderate to strong degree of control for prices/costs/channels of supply etc		CACP	0.4	0.51
- Barriers to entry for proprietary protection/lead time/legal advantage		CABE	0.1	0.42
- Product differentiation		CAPD	0.69	0.89
<u>Environmental uncertainty (EU) (Q41)</u>	F			
- Political infrastructure in society		EUPI	0.27	0.24
- Legal infrastructure		EULI	0.37	0.79
- Regulatory infrastructure		EURI	0.54	0.78
- Socio-cultural infrastructure		EUSI	0.09	0.52
- Financial infrastructure		EUFI	0.04	0.24
<u>Organisational strategy (OO) (Q42)</u>	F			
- Logistical infrastructure		OOLI	0.38	0.37
- Within-company infrastructure		OOCI	0.06	0.0
- Networks/contacts		OONC	-0.61	-0.76
- Management team expertise		OOMT	-0.53	-0.78
- Risk control		OORC	0.15	-0.1
Entrepreneurial leadership capacity (ELC): **<u>Types of Innovation (TI) (Q28)</u>**	R			
- New to the world product or service		TINW	0.0	0.07
- New to the firm product or service in line that at least one competitor is offering		TIFP	0.06	0.44
- New to the country and/or market product or service		TICM	-0.02	0.15
- New application of existing product or service, including application to a new market segment		TIEP	0.05	0.57
- Addition to a company's existing product or service line		TIAP	0.06	0.45
- Repositioning of an existing product or service		TIRP	0.08	0.66
- Product/service improvement, revision, including application of new feature or option or change		TIPS	0.02	0.25
- Process improvement for new administrative system or procedure		TINA	0.11	0.77
- Process improvement for new production		TINP	0.05	0.4

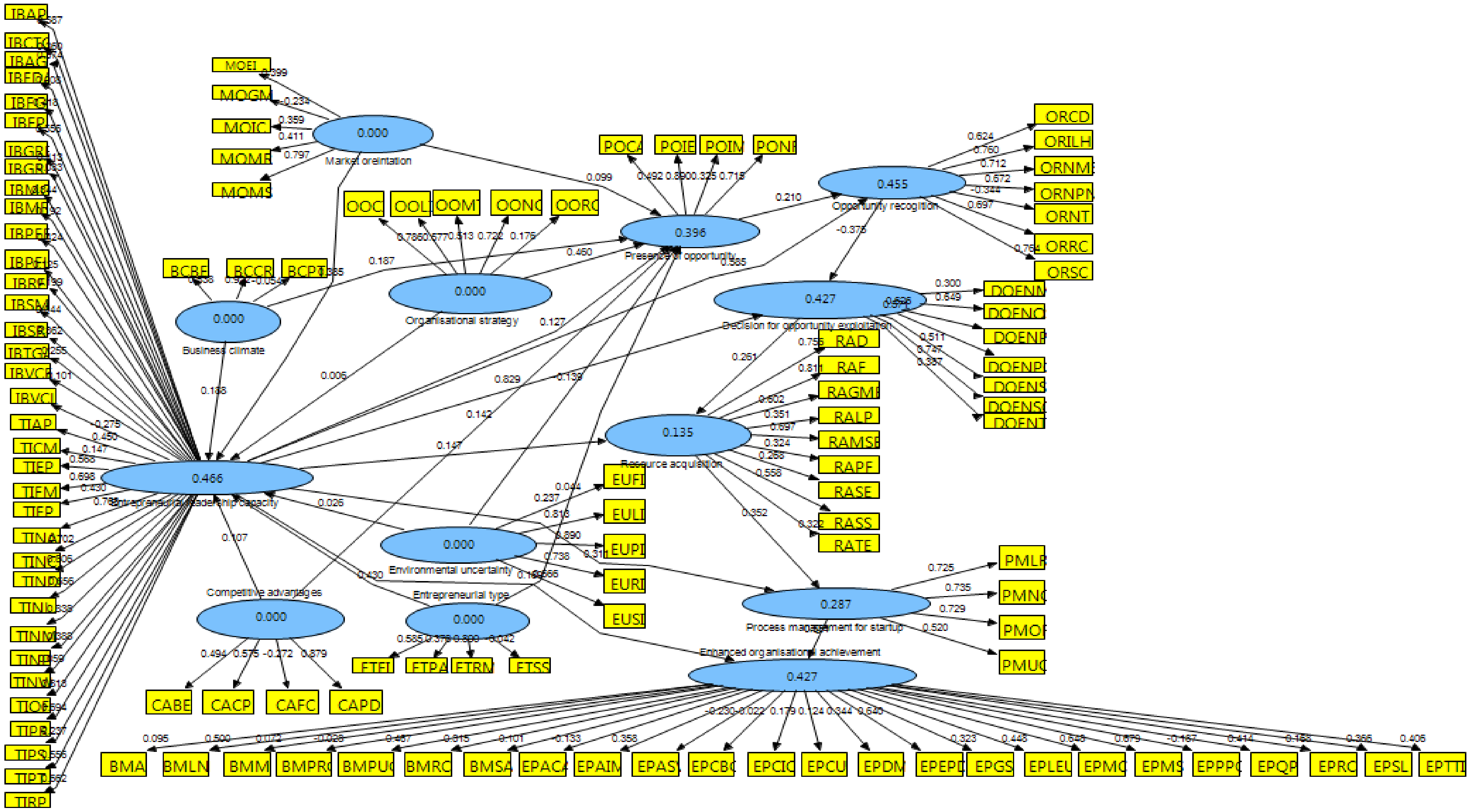
method				
- Process improvement for new marketing or sales approach		TINM	0.12	0.84
- Process improvement for new customer support program		TINC	0.08	0.7
- Process improvement for new logistical approach		TINL	0.07	0.66
- Process improvement for new pricing approach		TIPR	0.06	0.7
- Process improvement for new distribution channel or method		TIND	0.1	0.8
- Process improvement for new financing method		TIFM	0.09	0.7
- Process improvement for new purchasing technique		TIPT	0.05	0.56
- Process improvement for new organisational form or structure		TIOF	0.12	0.81
Recognition of innovation barriers (IB) (Q31)				
Financial				
- Lack of venture capital in early stage of venture		IBVCE	0	0.11
- Lack of public funds in early stage of venture		IBPFE	0.07	0.42
- Lack of government research funds in early stage of venture		IBGRE	0.06	0.41
- Lack of venture capital in late stage of venture		IBVCL	-0.05	-0.27
- Lack of public funds in late stage of venture		IBPFL	0.01	0.13
- Lack of government research funds in late stage of venture		IBGRL	0.01	0.03
Regulatory				
- Australian government regulations (eg state or federal)		IBAG	0.05	0.37
- Foreign government regulations (eg CE/EMEA approval etc)		IBFG	0.03	0.41
- Australian patent process				
- Foreign patent process		IBAP	0.08	0.58
- TGA approval process		IBFP	0.07	0.55
- FDA approval process		IBTGA	0.03	0.25
		IBFDA	0.01	0.2
Resource				
- Lack of skilled managers		IBSM	-0.01	0.04
- Lack of skilled researchers		IBSR	0.02	0.36
- Lack of research facilities/assets		IBRF	0.02	0.2
- Lack of manufacturing facilities		IBMF	0.01	0.19
- Lack of marketing/distribution channels		IBMC	0.05	0.34
- Lack of clinical trial facilities		IBCTG	0.05	0.35

Presence of opportunity (PO) (Q23)	R			
- In market (eg needs, customers and potential market size)		POIM	0.1	0.39
- In Economy (eg profits after tax and time to break even etc)		POIE	0.64	0.86
- In competitive advantage (eg barrier to entry, and degree of control over costs and prices etc)		POCA	0.21	0.53
- In network/management expertise/risk control		PONR	0.4	0.73
Opportunity recognition (OR) (Q23)	R			
- Changing demographics		ORCD	0.14	0.62
- Emergence of new market segments		ORNMS	0.23	0.71
- New process needs		ORNPN	0.25	0.67
- New technologies		ORNT	-0.14	-0.34
- Incongruities/ Lack of harmony		ORILH	0.28	0.76
- Regulatory change		ORRC	0.19	0.7
- Social change		ORSC	0.25	0.76
Decision for opportunity exploitation (DOE) (Q23)	R			
- New products		DOENP	0.33	0.62
- New services		DOENS	0.16	0.51
- New processes		DOENPC	0.26	0.57
- New markets		DOENM	0.04	0.3
- New organisational structure/forms		DOENOS	0.3	0.65
- New technologies		DOENT	0.24	0.38
- New sales or distribution channels		DOENSC	0.35	0.75
Resource acquisition (RA) (Q23)	R			
- Skilled employees		RASE	0.01	0.26
- General management expertise		RAGME	0.33	0.6
- Marketing and sales expertise		RAMSE	0.2	0.7
- Technical expertise		RATE	0.05	0.32
- Financing		RAF	0.34	0.81
- Distribution		RAD	0.3	0.76
- Source of supply		RASS	0.1	0.56
- Production facilities		RAPF	0.08	0.32
- Licences, patents and legal protection		RALP	0.16	0.35
Process management (PM) (Q23)	R			
- Absorption of new concept into mainstream operations		PMNC	0.47	0.73
- Licensing of rights with other company		PMLR	0.29	0.73
- Calculating the uncertainty of opportunities/risk		PMUO	0.2	0.52
- Company organisation design		PMOR	0.47	0.73
Enhanced organisational achievement (EOA):	R			
Business model (BM) (Q36)				
- Strategic alliance with partners		BMSA	-0.01	0.11
- Refocussed current product development		BMRCP	0.15	0.31
- Launch new products		BMLNP	0.1	0.5
- Raised public capital		BMPUC	0.14	0.47
- Raised private capital		BMPRC	-0.01	-0.03
- Acquisition		BMA	0	0.1
- Merger		BMM	0.02	0.08
Enterprise performance (EP) (Q37)				
- Managerial skills		EPMS	0.26	0.64
- Efficiency/speed of product development		EPEPD	0.16	0.64
- Skilled labour		EPSL	0.1	0.36
- Quality of product		EPQP	0.22	0.41
- Marketing capability		EPMC	0.29	0.68
- Collaboration with universities/research centres		EPCU	0.04	0.13

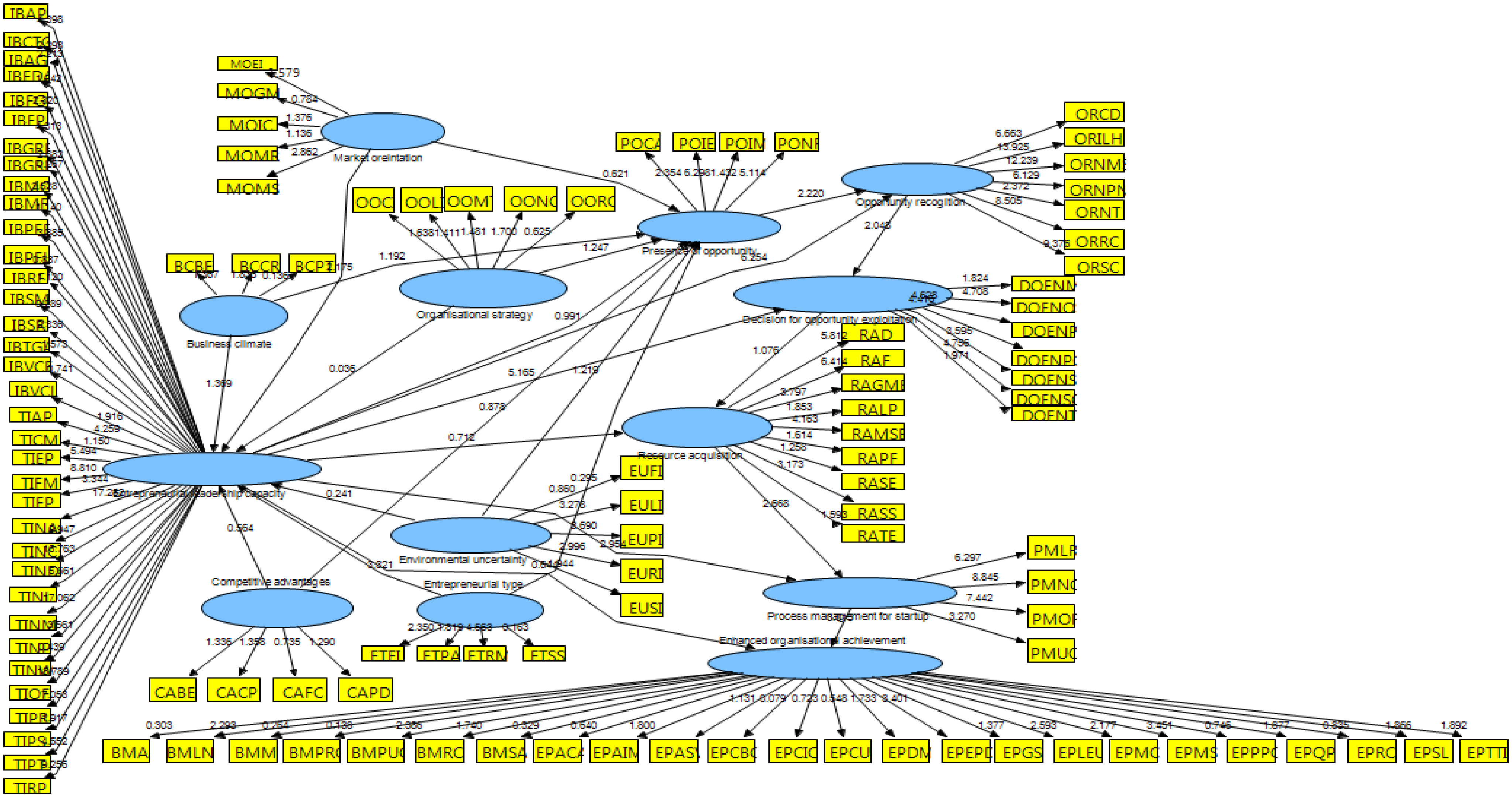
- Government support		EPGS	0.04	0.33
- Collaboration with industrial companies		EPCIC	0.05	0.18
- Access to seed/venture capital		EPASV	-0.01	-0.23
- Collaboration with other biotechnology companies		EPCBC	0.01	-0.02
- Access to domestic markets		EPDM	0.13	0.34
- Physical proximity to collaborators		EPPPC	-0.07	-0.18
- Access to international markets		EPAIM	0.13	0.36
- Ability to recognise commercial application of technology		EPACA	-0.04	-0.13
- Learning from end users		EPLEU	0.13	0.45
- Technology transfer from suppliers/ inventors		EPTTI	0.09	0.41
- Research capability		EPRC	0.08	0.17

Note: Type-R= reflective; F= formative

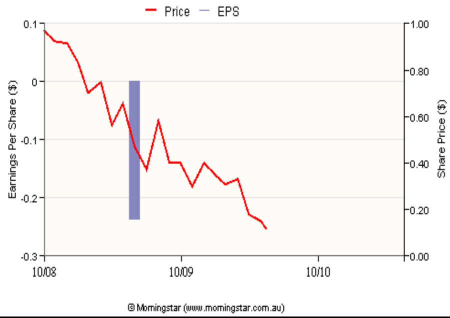
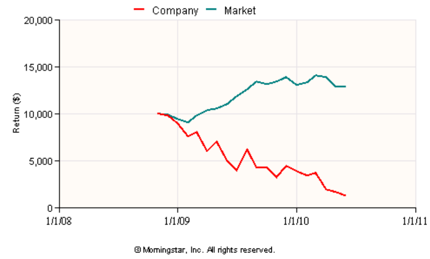
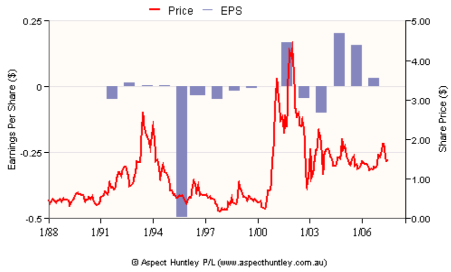
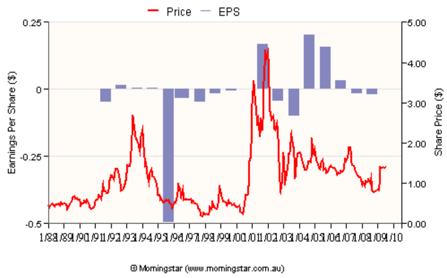
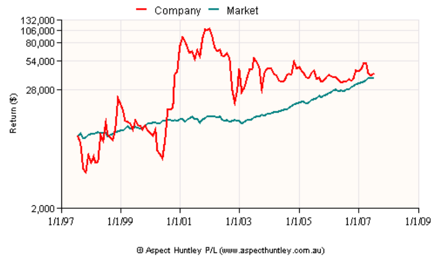
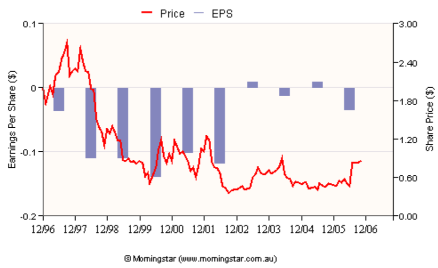
APPENDIX M: Overall path diagram for EELC model by SmartPLS (before the removal of low loading items)

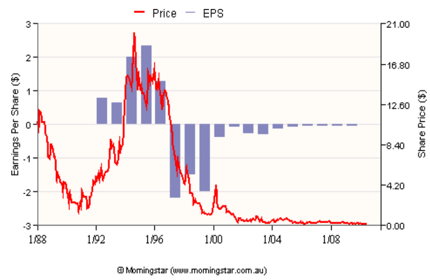
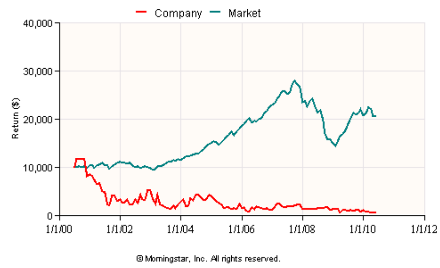
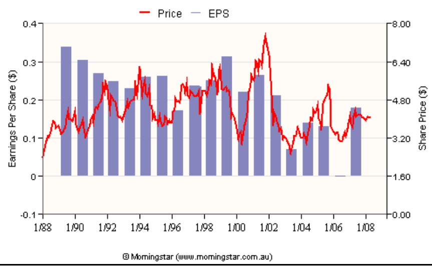
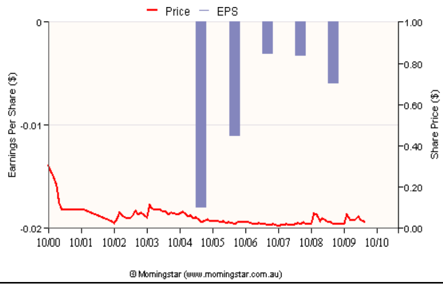
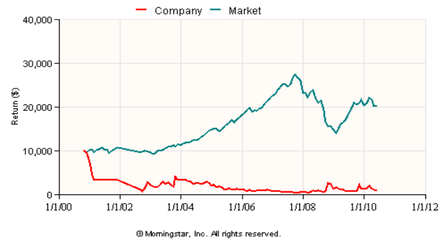
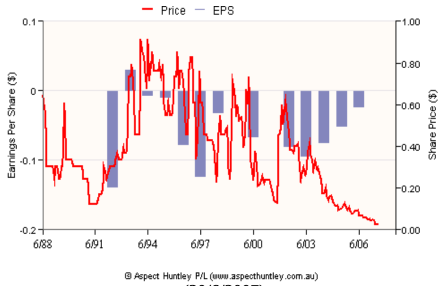
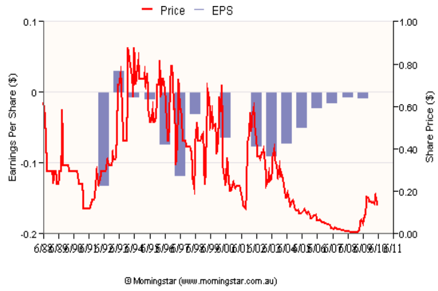
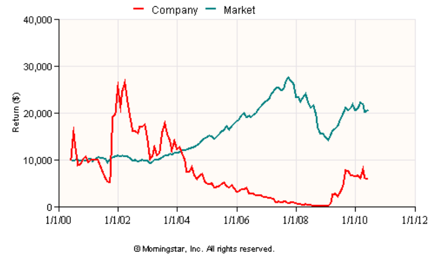


APPENDIX N: Overall path diagram for EELC model with bootstrapping by SmartPLS (before the removal of low loading items)



Appendix O: Business performance in Australian Stock Exchange (ASX) for the surveyed Australian listed biotechnology firms

Biotech company	Origin	Type	[1]Price vs EPS in ASX (15/6/2010)	[2]Ten Years Total Return in ASX (15/6/2010)
PA2 (NSW)	USO	PA		
New company (Merger between [PA5]() and SS3)	IV	PA	 (30/6/2007) 	 (30/6/2007)
PA6 (Delisted 17/11/2006)	IV	PA	 (30/6/2007)	N/A

Biotech company	Origin	Type	[1]Price vs EPS in ASX (15/6/2010)	[2]Ten Years Total Return in ASX (15/6/2010)
PA7	IV	PA		
PA8	IV	PA		N/A
PA9	IV	PA		
PA12	GRSO	PA	 **(30/6/2007)** 	

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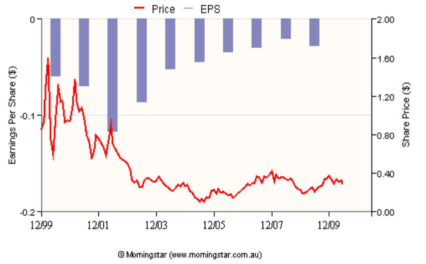
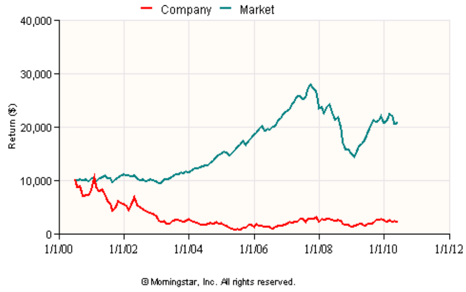
<tr><td>PA14</td><td>PI</td><td>PA</td><td>
</td><td>
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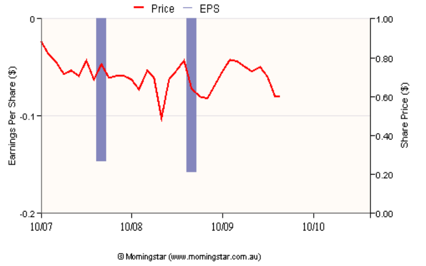
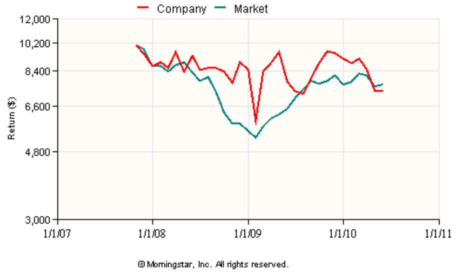
<tr><td>PA15</td><td>PI</td><td>PA</td><td>
</td><td>
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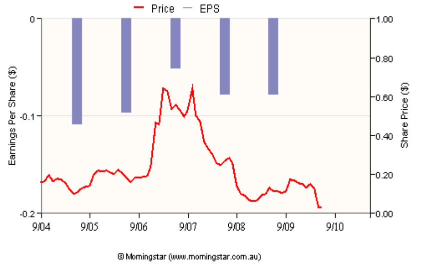
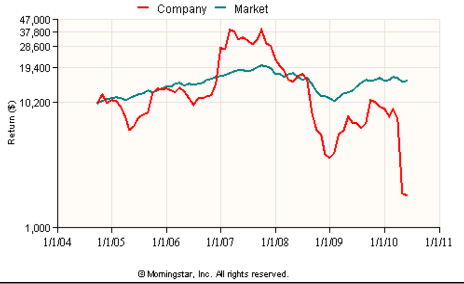
<tr><td>PA16</td><td>ISO</td><td>PA</td><td>
</td><td>
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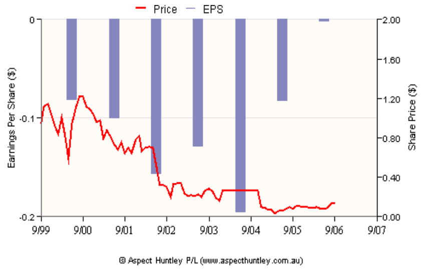
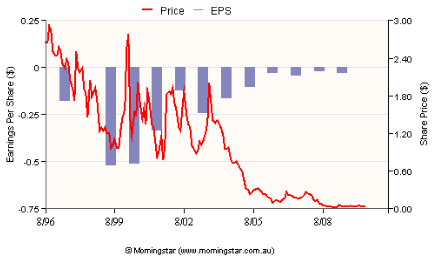
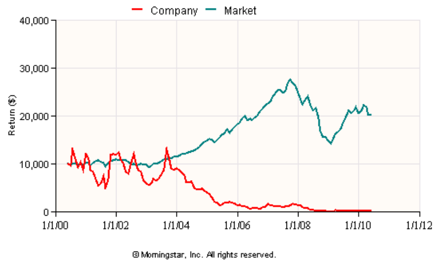
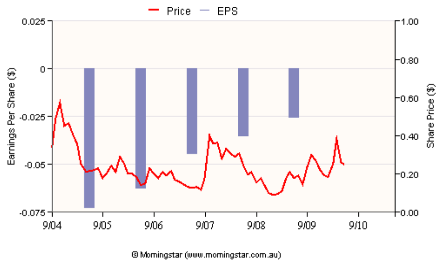
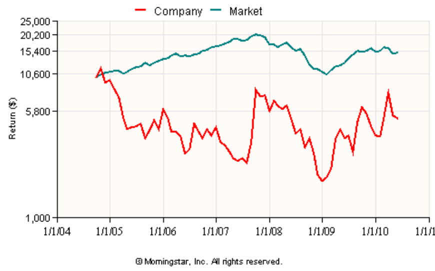
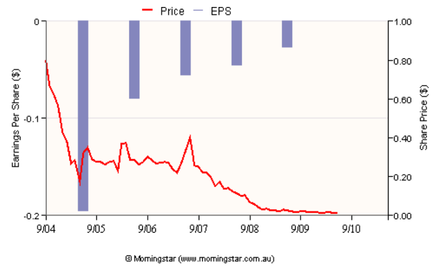
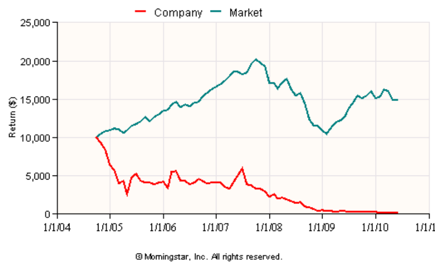
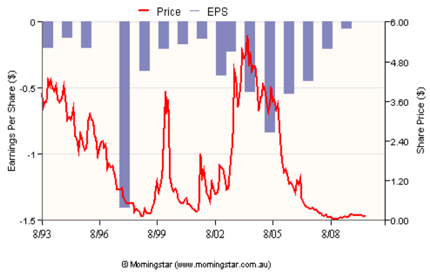
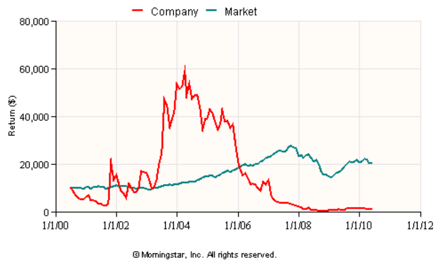
(08/01/2007
)</td><td>USO</td><td>EI</td><td>
(08/01/2007)</td><td>N/A</td></tr>
<tr><td>EI1</td><td>USO</td><td>EI</td><td></td><td></td></tr>
<tr><td>EI3</td><td>USO</td><td>EI</td><td></td><td></td></tr>
<tr><td>EI2</td><td>USO</td><td>EI</td><td></td><td></td></tr>
<tr><td>EI7</td><td>GRSO</td><td>EI</td><td></td><td></td></tr>
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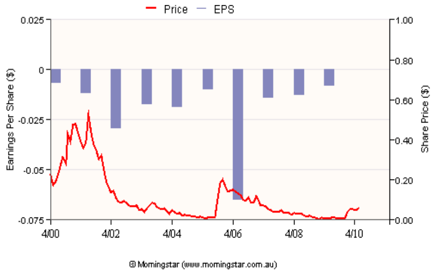
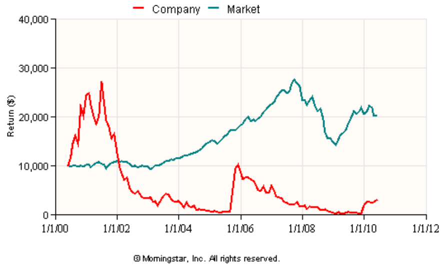
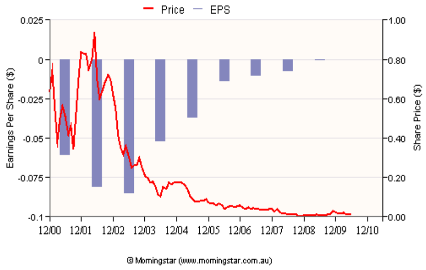
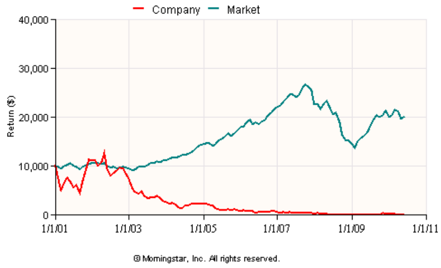
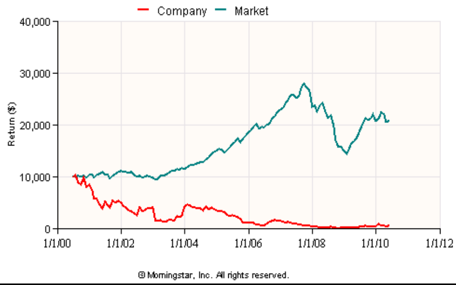
Biotech company	Origin	Type	[1]Price vs EPS in ASX (15/6/2010)	[2]Ten Years Total Return in ASX (15/6/2010)
EI6	IV	EI		
EI8	PI	EI		
EI9	PI	EI		

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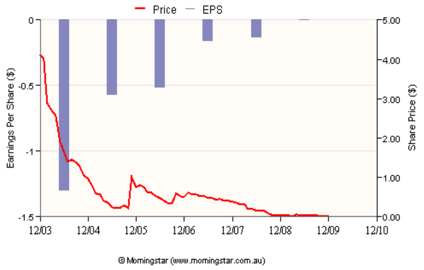
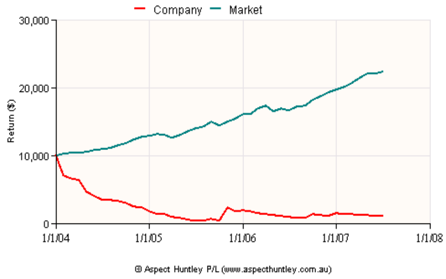
<tr><td>RM2 (Delisted 27/01/2010)</td><td>USO</td><td>RM</td><td>

(27/01/2010)</td><td>

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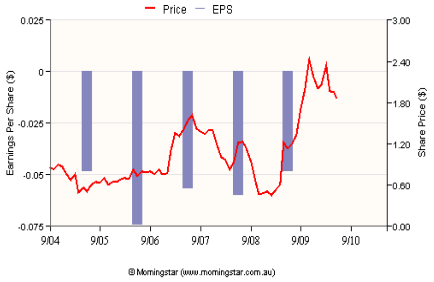
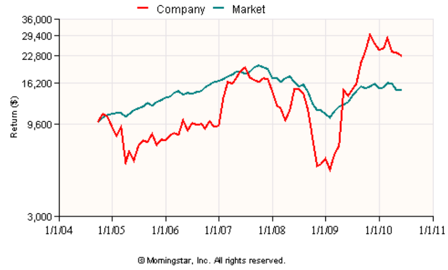
<tr><td>RM1</td><td>USO</td><td>RM</td><td>
</td><td>
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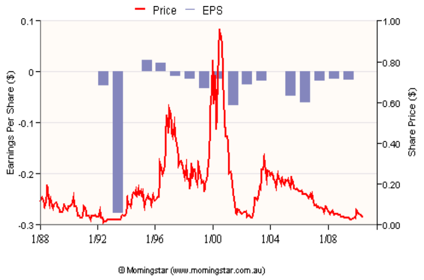
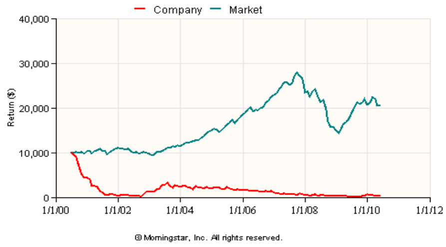
<tr><td>New company (Formerly from RM5)</td><td>IV</td><td>RM</td><td>
</td><td>
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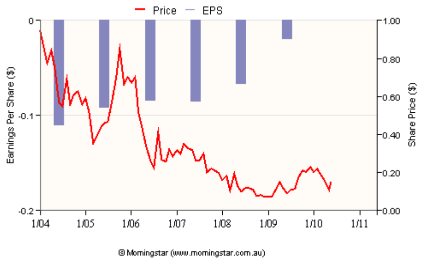
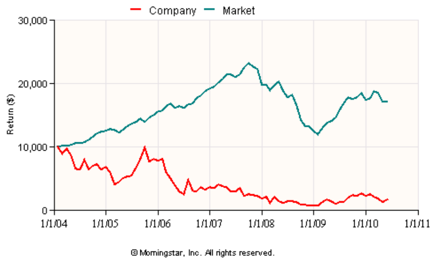
<tr><td>RM6</td><td>IV</td><td>RM</td><td>
</td><td>
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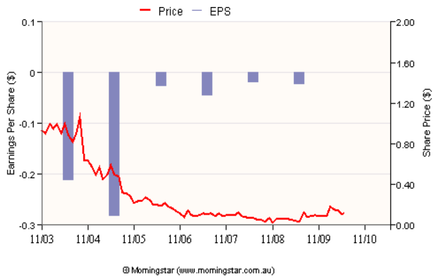

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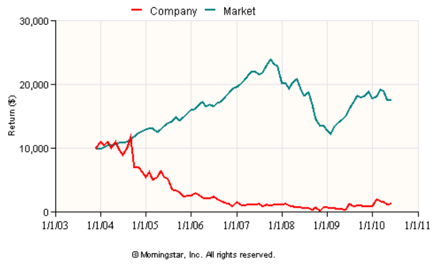

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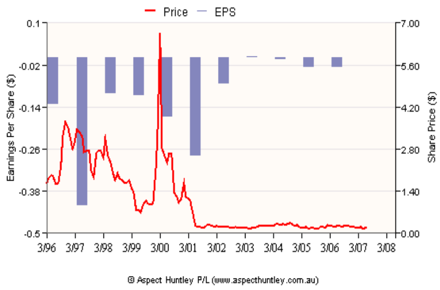

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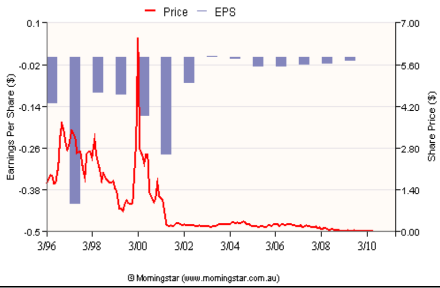

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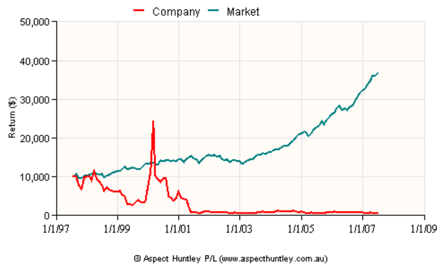

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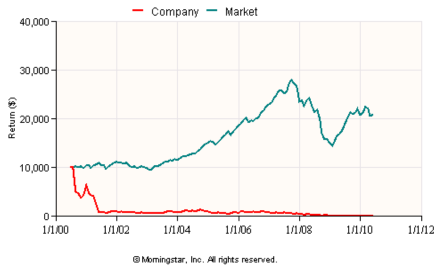

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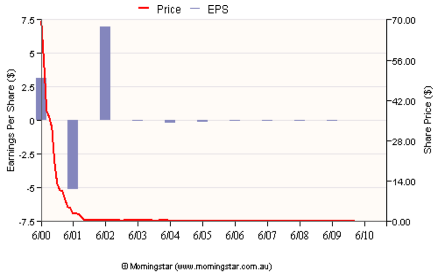
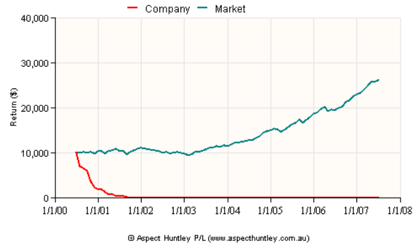
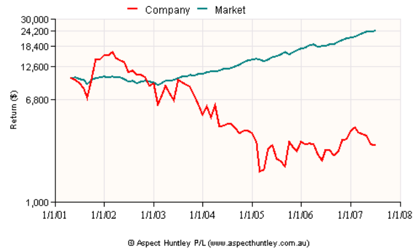
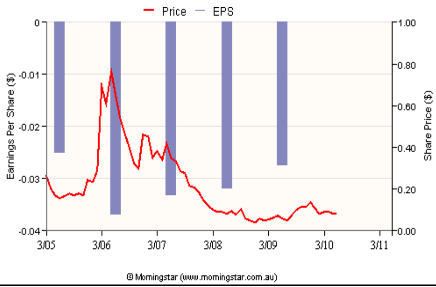
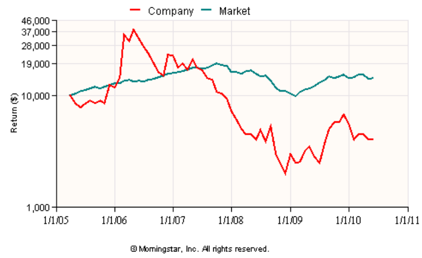
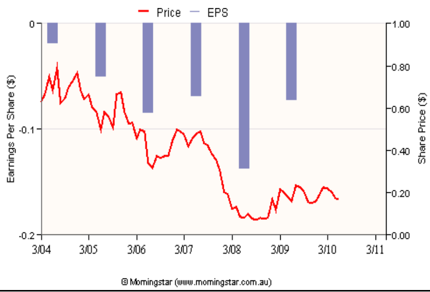
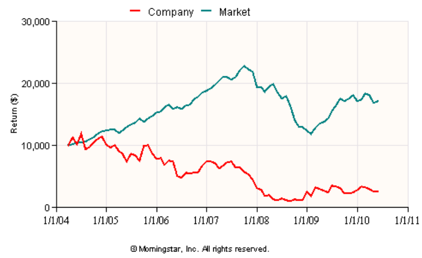
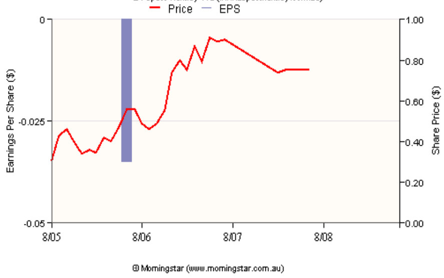
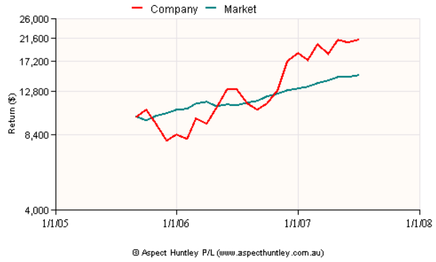
Biotech company	**Origin**	**Type**	**[1]Price vs EPS in ASX (15/6/2010)**	**[2]Ten Years Total Return in ASX (15/6/2010)**
SS1 (Suspended)	USO	SS	 (30/6/2007)	 (30/6/2007)
SS2 (Delisted 17/01/2008)	IV	SS	 (30/6/2007)	 (30/6/2007)
SS4	GRSO	SS		
SS5	PI	SS		

Biotech company	Origin	Type	[1]Price vs EPS in ASX (15/6/2010)	[2]Ten Years Total Return in ASX (15/6/2010)
SS3 (Delisted 23/07/2008) (Now formed with a new company) (Merger between PA5)	GRSO	SS	 (30/6/2007)	 (30/6/2007)

Note: NSW = New South Wales, Australia
VIC = Victoria, Australia
WA = Western Australia, Australia
QLD = Queensland, Australia
SA = South Australia, Australia
USO = University spin-off
GRSO = Government research institute/department spin-off
ISO = Industrial spin-off
CB = Corporate branch
IV = Independent venture
PI = Private investor + university collaboration
PA = Personal achiever
SS = Super sale people
RM = Real manager
EI = Expert idea generator

[1]**Price vs. EPS Chart:** This chart compares the monthly closing share price, adjusted for any dilutions, to the annual earnings per share, also adjusted for dilutions. Also included is the forecast earnings per share for the next two years, if available. This is a very useful chart as it shows at a glance the earnings history of the company and the prospects for the next two years. Generally, you will find that the share price will track the trend in earnings per share very closely. Deviations will generally occur because the earnings are ""low quality."" They may, for example, be inordinately affected by one-off write offs, tax exemptions, or the like.
(Source: http://www.aspectfinancial.com.au.simsrad.net.ocs.mq.edu.au/af/openrebasing?xtm-licensee=finanalysis)
[2]**Total Return Charts:** The charts show the total shareholder return, assuming the reinvestment of dividends. The chart compares this performance against the total market return, and against the return for the relevant industry sector. All three lines are indexed to the beginning of the period so that all start from a common basis. The charts traces monthly returns based on closing prices.
The charts also use a logarithmic scale. The dollar figures on the left hand increase in constant percentage terms rather than constant dollar terms. This is a much more accurate way of portraying growth over time because as share prices grow, larger dollar increases are needed to sustain a given growth rate. For example, if a company share price increases 10c from $1 to $1.10, this is a 10 percent increase. When the share price is $10, a $1 increase is needed to achieve the same 10 percent return.
(Source: http://www.aspectfinancial.com.au.simsrad.net.ocs.mq.edu.au/af/openrebasing?xtm-licensee=finanalysis)

Appendix P: Annual financial summary for the surveyed Australian listed biotechnology firms with personal achiever entrepreneurs (PA)

Annual Financial Summary (A$ millions)	PA2 (NSW)	New company (Merger with PA5 and SS3) (NSW)	PA6 (VIC)	PA7 (WA)	PA8 (SA)	PA9 (QLD)	PA12 (VIC)	PA14 (SA)	PA15 (QLD)	PA16 (VIC)
Origin & Entrepreneurial type	USO, PA	IV, PA	IV, PA	IV, PA	IV, PA	IV, PA	GRSO, PA	PI, PA	PI, PA	ISO, PA
Financial year	06/09	09/08	06/06	06/09	06/07	06/09	06/09	06/09	06/09	06/09
Profit & Loss										
Trading revenue	3.21	25.71	5.14	0.00	3826	0.03	0.00	4.01	3.04	1.02
Expenses	-8.92	-34.26	-9.02	-3.15	-3592	-2.11	-2.93	-10.19	-16.9	-39.15
EBIT	-5.71	-14.65	-4.45	-3.15	184.8	-1.93	-2.98	-6.90	-14.30	-37.6
NPAT	**-5.60**	**-4.09**	**-4.43**	**-3.04**	**91.42**	**-1.90**	**-2.95**	**-6.86**	**-14.03**	**-36.2**
Balance Sheet										
Cash	0.70	181.56	0.20	0.01	196.7	0.55	0.94	4.76	6.63	18.8
Total current assets	2.39	196.26	51.0	0.05	723.9	0.68	1.37	5.89	8.48	19.3
Goodwill	1.48	22.24	0.00	1.96	744.6	0.00	0.00	5.15	2.25	0.00
Investments	0.00	0.00	0.00	0.00	30.6	0.5	0.56	0.00	0.00	0.00
Total assets	**5.18**	**-329.5**	**52.6**	**2.02**	**2226**	**1.2**	**2.49**	**24.72**	**13.1**	**45.8**
Total liability	**1.5**	**25.44**	**3.28**	**1.14**	**1350.2**	**0.52**	**0.68**	**6.03**	**3.03**	**2.99**
Net assets	**3.68**	**304.07**	**49.4**	**0.88**	**875.7**	**0.68**	**1.81**	**18.69**	**10.07**	**42.8**
NTA	**1.27**	**182.47**	**49.4**	**-1.08**	**-285.2**	**0.68**	**1.27**	**8.24**	**6.27**	**17.0**
Cash Flow										
Operating cash flow	-4.21	6.16	-9.24	-1.62	174.7	-1.18	-1.88	-4.99	-11.79	-40.86
Investment cash flow	-2.93	8.04	-0.96	0.00	-116.3	-0.48	-0.00	0.18	-0.76	-0.64
Financing cash flow	7.50	-1.91	8.25	1.26	-48.27	1.26	1.73	3.33	10.63	16.92
Net cash increase	**0.36**	**12.29**	**-1.95**	**-0.36**	**10.17**	**-0.40**	**-0.16**	**-1.48**	**-1.91**	**-24.58**

Note: **EBIT** (Earnings Before Interest and Taxes): Reported earnings before tax, abnormals and net interest (interest revenue less interest expense); **NPAT**: Net profit after tax before capitalised interest
NTA: Net Tangible Assets Per Share(Shareholders equity - goodwill - other intangibles)/number of shares outstanding at the end of the period. Price to Earnings Ratio.
USO = University spin-off; **GRSO** = Government research institute/department spin-off; **ISO** = Industrial spin-off; **IV** = Independent venture; **PI** = Private investor + university collaboration; **PA** = Personal achiever;
SS = Super sale people; **RM** = Real manager; **EI** = Expert idea generator.
NSW = New South Wales, Australia; **VIC** = Victoria, Australia; **WA** = Western Australia, Australia; **QLD** = Queensland, Australia; **SA** = South Australia, Australia

Appendix Q: Annual financial summary for the surveyed Australian listed biotechnology firms with expert idea generator entrepreneurs (EI)

Annual Financial Summary (A$ millions)	EI14 Delisted (08/01/2007) (SA)	New company (formerly from EI1) (NSW)	EI3 (VIC)	EI2 (NSW)	New company (formerly from EI7) (WA)	New company (formerly from EI6l)	EI8 (NSW)	EI9 (VIC)
Origin & Entrepreneurial type	USO, EI	USO, EI	USO, EI	USO, EI	GRSO, EI	IV, EI	PI, EI	PI, EI
Financial year	06/06	06/09	06/09	06/09	06/09	06/09	06/09	06/09
Profit & Loss								
Trading revenue	5.67	0.44	0.19	1.56	2.93	0.23	1.10	0.00
Expenses	-4.77	-2.83	-7.05	-8.11	-7.42	-2.65	-1.32	-1.70
EBIT	0.24	-2.34	-6.51	-6.68	-5.37	-2.08	-0.18	-1.11
NPAT	**-0.29**	**-1.78**	**-6.12**	**-7.00**	**-5.13**	**-1.95**	**-0.21**	**-1.35**
Balance Sheet								
Cash	0.18	3.2	2.87	3.44	3.48	0.95	0.09	1.07
Total current assets	1.38	3.55	3.28	4.06	5.67	1.03	0.48	1.18
Goodwill	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Investments	0.00	0.38	0.00	0.00	0.00	0.00	0.00	0.00
Total assets	**12.09**	**3.94**	**6.50**	**4.58**	**9.83**	**1.33**	**0.49**	**1.18**
Total liability	**8.32**	**0.34**	**0.97**	**1.65**	**1.24**	**0.33**	**0.44**	**1.79**
Net assets	**3.78**	**3.59**	**5.53**	**2.93**	**8.59**	**1.03**	**0.04**	**-0.60**
NTA	**3.78**	**3.59**	**5.53**	**2.92**	**4.79**	**1.03**	**0.04**	**-0.60**
Cash Flow								
Operating cash flow	-1.46	-1.62	-5.70	-7.07	-4.69	-1.94	-0.49	-1.18
Investment cash flow	-0.49	-0.51	-2.36	0.02	-0.08	-0.20	0.00	0.03
Financing cash flow	0.82	0.00	-0.03	2.35	-0.26	-0.04	0.38	0.60
Net cash increase	**-1.13**	**-2.13**	**-8.10**	**-4.69**	**-5.03**	**-2.17**	**-0.11**	**-0.56**

Note: **EBIT** (Earnings Before Interest and Taxes): Reported earnings before tax, abnormals and net interest (interest revenue less interest expense); **NPAT**: Net profit after tax before capitalised interest
NTA: Net Tangible Assets Per Share(Shareholders equity - goodwill - other intangibles)/number of shares outstanding at the end of the period. Price to Earnings Ratio. **USO** = University spin-off;
GRSO = Government research institute/department spin-off; **ISO** = Industrial spin-off; **IV** = Independent venture; **PI** = Private investor + university collaboration; **PA** = Personal achiever; **SS** = Super sale people; **RM** = Real manager; **EI** = Expert idea generator; **NSW** = New South Wales, Australia; **VIC** = Victoria, Australia; **WA** = Western Australia, Australia; **QLD** = Queensland, Australia; **SA** = South Australia, Australia

Appendix R: Annual financial summary for the surveyed Australian listed biotechnology firms with real manager (RM) or super sales people entrepreneurs (SS)

Annual Financial Summary (A$ millions)	RM2 (WA)	RM1 (VIC)	RM5 (NSW)	RM6 (VIC)	New company (formerly from RM7)	New company (formerly from RM8)	SS1 (NSW)	SS2 (QLD)	SS4 (WA)	SS5 (QLD)
Origin & Entrepreneurial type	USO, RM	USO, RM	IV, RM	IV, RM	IV, RM	GRSO, RM	USO, SS	IV, SS	GRSO, SS	PI, SS
Financial year	06/09	06/09	06/09	06/09	06/09	06/09	06/09	06/07	06/09	06/09
Profit & Loss										
Trading revenue	0.94	1.32	0.00	2.99	0.14	4.56	0.09	18.95	1.27	0.25
Expenses	-3.25	-10.62	-4.13	-4.59	-2.35	-6.17	-3.91	-18.61	-5.76	-4.92
EBIT	-3.35	-9.29	-4.66	-1.59	-2.29	-1.45	-3.92	0.42	-4.60	-4.68
NPAT	**-2.96**	**-7.72**	**-4.59**	**-1.51**	**-1.94**	**-1.67**	**-3.88**	**0.55**	**-4.49**	**-4.47**
Balance Sheet										
Cash	0.74	14.74	1.31	3.99	0.22	0.99	0.09	4.43	3.07	0.79
Total current assets	1.03	15.35	1.44	4.05	0.28	2.42	0.13	12.03	3.41	2.30
Goodwill	0.00	0.00	0.00	0.00	1.89	0.00	0.00	0.76	0.00	0.00
Investments	0.00	0.00	0.53	0.00	0.00	1.09	0.00	0.00	0.00	0.00
Total assets	**8.47**	**34.95**	**6.54**	**4.06**	**2.73**	**4.75**	**0.13**	**16.90**	**3.49**	**4.14**
Total liability	**5.16**	**3.73**	**1.65**	**0.07**	**0.72**	**0.82**	**0.24**	**3.98**	**1.58**	**0.45**
Net assets	**3.31**	**31.22**	**4.89**	**3.99**	**2.00**	**3.93**	**-0.10**	**12.92**	**1.91**	**3.69**
NTA	**-4.11**	**14.25**	**0.52**	**3.99**	**0.04**	**3.93**	**-0.10**	**10.55**	**1.91**	**3.35**
Cash Flow										
Operating cash flow	-1.27	-5.78	-3.17	-1.52	-1.14	-0.54	-1.46	0.79	-3.88	-2.47
Investment cash flow	-0.02	-13.92	-0.10	0.00	-0.13	-2.76	0.00	-0.95	-0.01	0.00
Financing cash flow	1.19	0.08	1.73	0.00	0.89	1.25	0.35	0.03	3.73	2.75
Net cash increase	**-0.09**	**-19.63**	**-1.54**	**-1.52**	**-0.38**	**-2.05**	**-1.11**	**-0.12**	**-0.16**	**0.27**

Note: **EBIT** (Earnings Before Interest and Taxes): Reported earnings before tax, abnormals and net interest (interest revenue less interest expense); **NPAT**: Net profit after tax before capitalised interest
NTA: Net Tangible Assets Per Share(Shareholders equity - goodwill - other intangibles)/number of shares outstanding at the end of the period. Price to Earnings Ratio.
USO = University spin-off; **GRSO** = Government research institute/department spin-off; **ISO** = Industrial spin-off; **IV** = Independent venture; **PI** = Private investor + university collaboration; **PA** = Personal achiever;
SS = Super sale people; **RM** = Real manager; **EI** = Expert idea generator.
NSW = New South Wales, Australia; **VIC** = Victoria, Australia; **WA** = Western Australia, Australia; **QLD** = Queensland, Australia; **SA** = South Australia, Australia

Appendix S: Price sensitive measures for the surveyed Australian listed biotechnology firms with personal achiever entrepreneurs (PA)

Annual Financial Summary (A$ millions)	PA2 (NSW)	New company (Merger with PA5 and SS3) (NSW)	PA6 (VIC)	PA7 (WA)	PA8 (SA)	PA9 (QLD)	PA12 (VIC)	PA14 (SA)	PA15 (QLD)	PA16 (VIC)
Origin & Entrepreneurial type	USO, PA	IV, PA	IV, PA	IV, PA	IV, PA	IV, PA	GRSO, PA	PI, PA	PI, PA	ISO, PA
Financial year	14/01/2010	14/01/2010	14/01/2010	14/01/2010	14/01/2010	14/01/2010	14/01/2010	14/01/2010	14/01/2010	14/01/2010
Previous close (A$)	$0.35			$0.2		$0.04	$0.04	$0.34	$0.75	$0.15
Dividend yield	0.00%	No	No	0.00%	No	0.00%	0.00%	0.00%	0.00%	0.00%
PER	--	Data	Data	--	Data	--	--	--	--	--
Market cap. (A$m)	11.04			19.29		15.31	93.96	106.57	81.56	127.15
Enterprise value (EV) (A$m)	10.35			19.28		15.11	93.26	105.51	74.93	108.33
EV/EBITDA	-1.81			-6.11		-7.88	-31.9	-18.0	-5.54	-2.90
EV/EBIT	-1.81			-6.10		-7.84	-31.3	-15.3	-5.24	-2.88
Mkt cap/rep. NPAT	-1.97			-6.34		-8.05	-31.9	-15.5	-5.81	-3.51
Mkt cap/revenue	3.44			--		478.3	--	26.6	26.8	124.8
Price/book value	3.00			22.0		22.5	51.8	5.70	8.10	2.97

Note:
PER: Price to Earnings Ratio is a valuation measure that divides the company's share price by its pre-abnormals earnings per share;
Market Cap: It is the market value of the company's equity capital. This is calculated by multiplying the number of common shares by the current price.
Enterprise value (EV): Market cap + total debt - cash
EV/EBIT: Economic value/earnings before interest and tax.
EV/EBITDA: Economic value/earnings before interest, tax, depreciation and amortisation.
Market Cap to Reported Net Profit After Tax: Market cap/net profit after tax after abnormal
Market Cap to Trading Revenue: Market cap/operating revenue
Price to Book Value: Closing share price on the last day of the company's financial year /shareholders equity per share
USO = University spin-off; **GRSO** = Government research institute/department spin-off; **ISO** = Industrial spin-off; **IV** = Independent venture; **PI** = Private investor + university collaboration; **PA** = Personal achiever; **SS** = Super sale people; **RM** = Real manager; **EI** = Expert idea generator.
NSW = New South Wales, Australia; **VIC** = Victoria, Australia; **WA** = Western Australia, Australia; **QLD** = Queensland, Australia; **SA** = South Australia, Australia

Appendix T: Price sensitive measures for the surveyed Australian listed biotechnology firms with expert idea generator entrepreneurs (EI)

Annual Financial Summary (A$ millions)	EI14 Delisted (08/01/2007) (SA)	New company (formerly from EI1) (NSW)	EI3 (VIC)	EI2 (NSW)	New company (formerly from EI7) (WA)	New company (formerly from EI6l)	EI8 (NSW)	EI9 (VIC)
Origin & Entrepreneurial type	USO, EI	USO, EI	USO, EI	USO, EI	GRSO, EI	IV, EI	PI, EI	PI, EI
Financial year	06/2006	16/6/2010	16/6/2010	16/6/2010	16/6/2010	16/6/2010	16/6/2010	16/6/2010
Previous close (A$)		$0.03	$0.25	$0.01	$0.14	$0.06	$0.01	$0.08
Dividend yield	No	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
PER	Data	--	--	--	--	--	--	--
Market cap. (A$m)		1.86	68.47	5.48	14.38	30.75	3.53	14.02
Enterprise value (EV) (A$m)		-1.34	65.64	2.05	10.90	29.80	3.49	14.46
EV/EBITDA		0.59	-10.49	-0.32	-2.46	-15.1	-20.4	-13.1
EV/EBIT		0.57	-10.08	-0.31	-2.03	-14.4	-19.9	-13.1
Mkt cap/rep. NPAT		-1.05	-11.2	-0.78	-2.80	-15.8	-16.7	-10.42
Mkt cap/revenue		4.22	367.2	3.52	4.90	135.9	3.20	--
Price/book value		0.52	12.4	1.87	1.67	29.8	81.8	-23.2

Note:**PER**: Price to Earnings Ratio is a valuation measure that divides the company's share price by its pre-abnormals earnings per share; **Market Cap**: It is the market value of the company's equity capital. This is calculated by multiplying the number of common shares by the current price; **Enterprise value (EV)**: Market cap + total debt - cash
EV/EBIT: Economic value/earnings before interest and tax; **EV/EBITDA**: Economic value/earnings before interest, tax, depreciation and amortisation.
Market Cap to Reported Net Profit After Tax: Market cap/net profit after tax after abnormal; **Market Cap to Trading Revenue**: Market cap/operating revenue; **Price to Book Value:** Closing share price on the last day of the company's financial year /shareholders equity per share
USO = University spin-off; **GRSO** = Government research institute/department spin-off; **ISO** = Industrial spin-off; **IV** = Independent venture; **PI** = Private investor + university collaboration; **PA** = Personal achiever; **SS** = Super sale people; **RM** = Real manager; **EI** = Expert idea generator.
NSW = New South Wales, Australia; **VIC** = Victoria, Australia; **WA** = Western Australia, Australia; **QLD** = Queensland, Australia; **SA** = South Australia, Australia

Appendix U: Price sensitive measures for surveyed Australian listed biotechnology companies with real manager (RM) or super sales people (SS) entrepreneur

Annual Financial Summary (A$ millions)	RM2 (WA)	RM1 (VIC)	RM5 (NSW)	RM6 (VIC)	New company (formerly from RM7)	New company (formerly from RM8)	SS1 (NSW)	SS2 (QLD)	SS4 (WA)	SS5 (QLD)
Origin & Entrepreneurial type	USO, RM	USO, RM	IV, RM	IV, RM	IV, RM	GRSO, RM	USO, SS	IV, SS	GRSO, SS	PI, SS
Financial year	14/01/2010	14/01/2010	14/01/2010	14/01/2010	16/6/2010	16/6/2010	14/01/2010	14/01/2010	14/01/2010	14/01/2010
Previous close (A$)		$2.00	$0.07	$0.20	0.12	$0.01	$0.02		$0.11	$0.19
Dividend yield		0.00%	0.00%	0.00%	0.00%	0.00%	0.00%		0.00%	0.00%
PER	No	--	--	--	--	--	--	No	--	--
Market cap. (A$m)	Data	320.76	26.22	15.28	17.68	2.40	3.00	Data	25.93	26.26
Enterprise value (EV) (A$m)		306.03	25.17	11.28	17.71	1.41	2.90		23.89	25.47
EV/EBITDA		-35.2	-6.09	-7.08	-8.16	-1.05	-0.76		-5.33	-5.46
EV/EBIT		-32.9	-5.41	-7.08	-7.73	-0.98	-0.74		-5.20	-5.44
Mkt cap/rep. NPAT		-41.6	-5.72	-10.09	-9.11	-1.12	-0.77		-5.77	-5.87
Mkt cap/revenue		242.5	--	5.10	129.1	0.53	34.5		-20.3	103.8
Price/book value		10.27	5.36	3.83	8.82	0.61	-78.6		13.6	7.12

Note:
PER: Price to Earnings Ratio is a valuation measure that divides the company's share price by its pre-abnormals earnings per share;
Market Cap: It is the market value of the company's equity capital. This is calculated by multiplying the number of common shares by the current price.
Enterprise value (EV): Market cap + total debt - cash
EV/EBIT: Economic value/earnings before interest and tax.
EV/EBITDA: Economic value/earnings before interest, tax, depreciation and amortisation.
Market Cap to Reported Net Profit After Tax: Market cap/net profit after tax after abnormal
Market Cap to Trading Revenue: Market cap/operating revenue
Price to Book Value: Closing share price on the last day of the company's financial year/shareholders equity per share
USO = University spin-off; **GRSO** = Government research institute/department spin-off; **ISO** = Industrial spin-off; **IV** = Independent venture; **PI** = Private investor + university collaboration; **PA** = Personal achiever; **SS** = Super sale people; **RM** = Real manager; **EI** = Expert idea generator.
NSW = New South Wales, Australia; **VIC** = Victoria, Australia; **WA** = Western Australia, Australia; **QLD** = Queensland, Australia; **SA** = South Australia, Australia

APPENDIX V: Partial Least Squares Path Modeling (PLS-PM) for Structural Equation Modeling (SEM)

4.6 Partial Least Squares Path Modeling (PLS-PM) for Structural Equation Modeling (SEM)

In the discipline of Statistics, those concepts of interest and variables which are not observed or measured directly are present very commonly in social sciences. In these cases they are referred as theoretical constructs or latent variables. For instance, psychologists speak of satisfaction while sociologists refer to social status. Economists speak of economic development. When researchers work with theoretical concepts, they usually conceive of expected relationships between two or more latent variables, they analyse the relationships, and propose theories and models. For such purposes structural equation modeling (SEM) is a statistical methodology with great flexibility and modeling power (Kline 2011).

Structural equation models have been gaining popularity since the beginning of the 1970s (Kline 2011). SEM is a technique that tests and estimates causal relationships by using a combination of qualitative causal assumptions and statistical data (Pearl 2000). They are characterised by evaluating relationships between latent variables. These are conceptualised by indicators that reflect or influence them. Structural equation modeling is second-generation multivariate statistical techniques (Fornell 1982). In contrast to first-generational techniques, such as regression and cluster analysis, SEM permits the explicit inclusion of measurement error, and the incorporation of unobservable and abstract constructs (Fornell 1982). Bagozzi and Yi (1988) identified four key benefits of SEM:

- The assumptions, constructs, and hypothesised relationships in a model are made explicit;

- Theoretical precision is enhanced, because SEM require clear definitions of constructs, operationalisations, and functional relationships;
- SEM permits a more complete representation of complex theories; and
- SEM provides a formal framework for constructing and testing both theories and measurement models.

In this overview section, the following will be discussed: the basics of path modeling for Structural Equation Modeling (SEM), the comparison for Covariance-Based Structural Equation Modeling (CBSEM) and Variance-Based Structural Equation Modeling for Partial Least Squares Path Modelling (PLS-PM).

4.6.1 Basics of path modeling for Structural Equation Modeling (SEM)

Path Modeling, also known as Structural Equation Modeling (SEM), is one of the major components of multivariate statistical analysis techniques. It provides a flexible and powerful method for analysing multiple relationships between a set of blocks of variables (Anderson & Swaminathan 2011). Path models are used by economists, business people, educational researchers, marketing researchers, biologists, medical researchers, and a variety of other social and behavioural scientists (Anderson & Swaminathan 2011; Henseler, Ringle & Sinkovics 2009; Lee, Petter, Fayard & Robinson 2011; Esposito Vinzi, Trinchera & Amato 2010). The concept of structural equations simply refers to the fact that the structure of cause-effect relationships between variables can be specified by a series of equations. In turn, the concept of path modeling refers to the graphical display of the structural equations in what is known as a path diagram. One of the main features of path modeling techniques is the ability to deal with latent variables.

Simply stated, latent variables are hypothetical or theoretical variables that cannot be observed or measured directly (Tenenhaus, Vinzi, Chatelin & Lauro 2005). Because these types of variables cannot be measured explicitly, they have to be measured (or constructed) through variables that are perfectly observable/measurable.

Latent Variables

Sometimes we must face the fact that the variables of interest in our models cannot be observed or measured directly. Examples of these kinds of variables are concepts such as motivation, confidence, self-esteem, and in general, different attitudes and mental abilities related with the psychological theories of human behaviour. These variables are known as latent variables (LVs). Within the literature related to latent variables, synonymous terms are found like: theoretical concepts, hypothetical variables, constructs, factors, and intangibles. These types of variables are very common in the social sciences (e.g. psychology, sociology, economy, and politics) in which there are many concepts of theoretical nature such as intelligence, socio-economic status, industrial development or democracy. In fact, it is not a coincidence that many examples of latent variables come from psychology since it was in this discipline where the concept originated.

In statistics, LVs are widely used in several data analysis and modeling techniques with applications in many fields of knowledge. Despite its wide use, there is no single general definition of a latent variable. Bollen (2002) discusses the different ways that latent variables can be conceived and he distinguishes among three approaches:

- Latent variables seen as something that comes from the mind of the researcher, that is, LVs are not real but only hypothetical variables or constructs that only exist in the minds of analysts.
- Latent variables considered as real but being unobservable or non-measurable variables.
- Latent variables are taken as a data reduction device or factor; that is, a means of summarising a number of variables into many fewer factors aiming to attain a parsimonious description of observed data.

It is important to note that there are two major types of variables in SEM that one considers: latent and manifest variables. As its name suggests, manifest variables are defined and measured directly. An example of a manifest variable is gender or marital status. Latent variables are indirectly observed and inferred from manifest variables. For example, quality of life is a latent variable that can be measured in a number of ways, including (Pearl 2000):

1. Monetary indicators: GDP per capita and employment rate;
2. Social indicators: Human Development Index (HDI), environment physical and mental health, education, recreation and leisure time.

Reflective and Formative Measurement

Once it has been assumed that latent variables can only be observed and measured indirectly through the use of manifest variables, it is necessary to consider the ways in which latent variables are indirectly measured. Latent variables can be observed/measured in two ways:

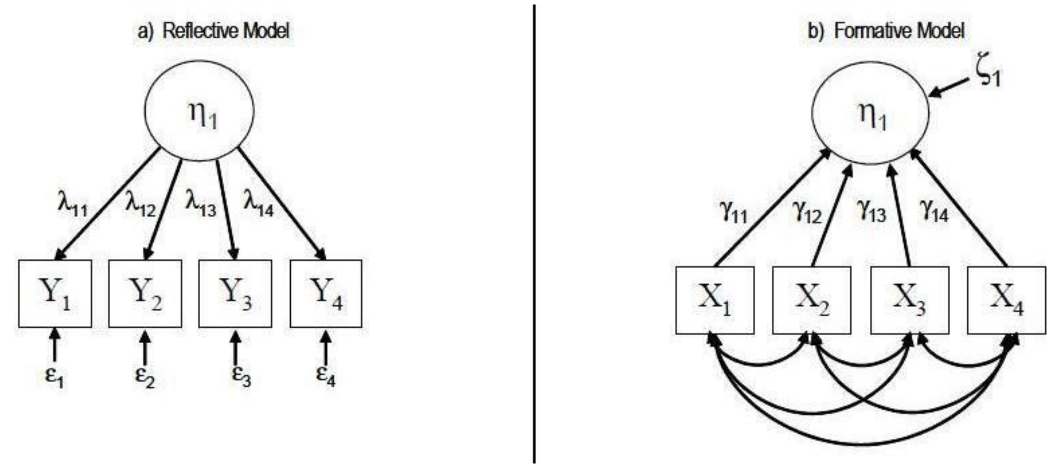
- through their consequences or effects reflected on their indicators
- through different indicators that are assumed to cause the latent variables.

In the first case, which is called reflective way, manifest variables are considered as being caused by the latent variables. The second case is known as formative way because the latent construct is supposed to be formed by its indicators (Diamantopoulos & Winklhofer 2001). The main difference between the reflective and formative ways has to do with the causal-effect relationships between the indicators and the constructs.

Although there are no rules associated with the number of *manifest* variables to infer *latent* variables, multiple manifest variables are used per latent construct when there is either a chance of significant measurement error or the latent construct is complex (Linton 2004). The relationship between a *manifest* variable(s) and a *latent* variable can be either *reflective* or *formative*. In a *reflective* model (Figure 4.2a), the latent variable is considered as the common cause of a manifest behaviour. The causal action flows from the latent variable to the indicators (Edwards & Bagozzi 2000). Therefore, any change in the latent variable results in a change in indicator behaviour. On the contrary, manipulation of an indicator may not have an effect on the latent variable. In a *reflective* model, arrows point towards manifest variables and emanate from the latent construct (Linton 2004).

In a *formative* model, (Figure 4.2b), there is a *causal relation* between the latent construct and manifest variables. In other words, the latent construct is defined by associated manifest variable(s). In formative models, it is crucial to use all relevant measures in the model (Linton 2004).

Figure 4.2 Reflective and formative measurement models



$Y_i = \beta_{i1} X_1 + \varepsilon_i$

Where Y_i = the i^{th} indicator
β_{i1} = coefficient representing effect of latent variable on indicator
X_1 = latent variable (or reflective construct)
ε_i = measurement error for indicator i

$Y = \beta_1 X_1 + \ldots \beta_n X_n + \zeta$

Where Y = the construct being estimated
β_i = beta weights for items
X_i = item scores/observations
ζ = a disturbance term

Source: Adopted from Petter, Straub & Rai (2007)

Table 4.5 provides a comprehensive comparison of formative and reflective models. Generally, reflective indicators are widespread and only a small proportion of SEM-based studies have applied formative measurement models. The use of reflective measurement models was considered the norm and researchers did not question those that they applied (Urbach & Ahlemann 2010).

Table 4.5 Comparison of formative and reflective measurement models

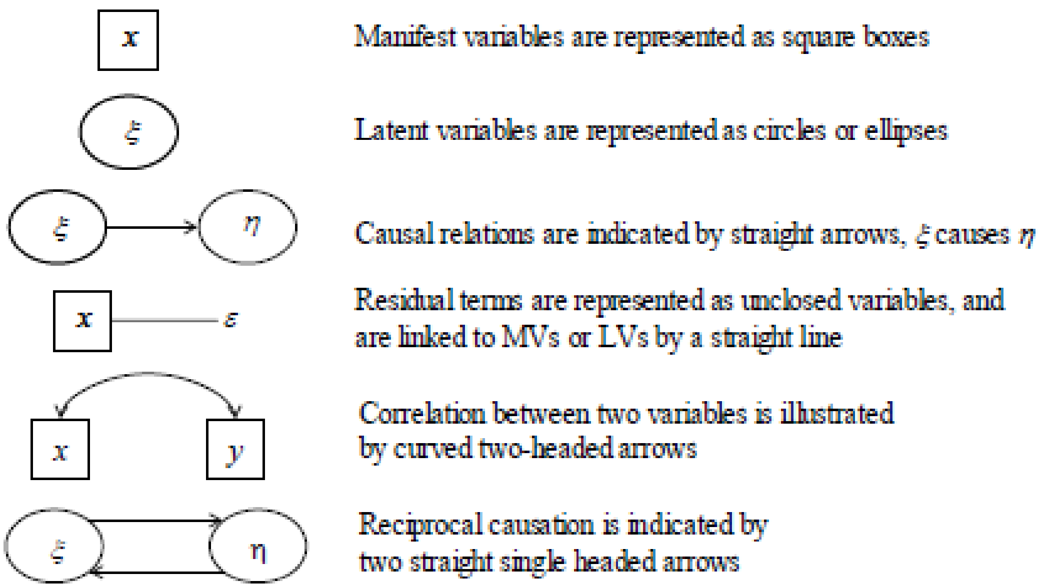
Criteria	Formative Model	Reflective Model
1. Direction of causality from construct to measure implied by the conceptual definition	*Direction of causality is from items to construct.*	*Direction of causality is from construct to items.*
Are the indicators (items) (a) defining characteristics or (b) manifestations of the construct?	Indicators are defining characteristics of the construct.	Indicators are manifestations of the construct.
Would changes in the indicators/items cause changes in the construct or not?	Changes in the indicators should cause changes in the construct.	Changes in the indicator should not cause changes in the construct.
Would changes in the construct cause changes in the indicators?	Changes in the construct do not cause changes in the indicators.	Changes in the construct do cause changes in the indicators.
2. Interchangeability of the indicators/items	*Indicators need not be interchangeable.*	*Indicators should be interchangeable.*
Should the indicators have the same or similar content? Do the indicators share a common theme?	Indicators need not have the same or similar content/indicators need not share a common theme.	Indicators should have the same or similar content/indicators should share a common theme.
Would dropping one of the indicators alter the conceptual domain of the construct?	Dropping an indicator may alter the conceptual domain of the construct.	Dropping an indicator should not alter the conceptual domain of the construct.
3. Covariation among the indicators	*Not necessary for indicators to covary with each other*	*Indicators are expected to covary with each other.*
Should a change in one of the indicators be associated with changes in the other indicators?	Not necessarily	Yes
4. Nomological net of the construct indicators	*Nomological net of the indicators may differ.*	*Nomological net of the indicators should not differ.*
Are the indicators/items expected to have the same antecedents and consequences?	Indicators are not required to have the same antecedents and consequences.	Indicators are required to have the same antecedents and consequences.

Source: Urbach & Ahlemann (2010)

Variables can be of any kind: manifest variables, latent variables, or residual variables (disturbance terms). Observed variables are enclosed in boxes; latent variables are enclosed in circles/ellipses, and residual terms are maintained unclosed. Relationships also can be of three types: causal links meaning that variable A causes variable B; correlation links indicating simply a correlation between two variables A and B without implying causality; or the affection of a residual term ε to some variable A. Causal relationships are assumed to be linear, and are represented by straight single-headed arrows, correlations are represented by curved two-headed arrows, and residual affection by straight lines (Kline 2011).

In addition, variables may be grouped in two classes: (1) those that are caused by one or more variables, and those that are not caused by any other variables in the diagram. The first class of variables is called endogenous or dependent variables. The second class is known as exogenous or independent variables. The convention is to use Greek letters for the latent variables, and Italic letters for the manifest ones. Exogenous latent variables are usually represented by the Greek letter ξ (X_1), while endogenous latent variables are represented by η (eta). Figure 4.3 shows the path diagram notation.

Figure 4.3 The path diagram notation



Source: Kline (2011)

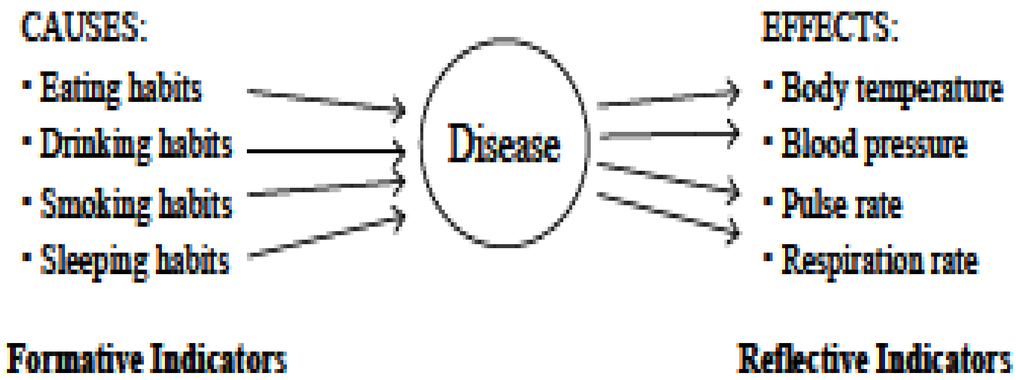
To better understand the difference between reflective and formative models, the following analogy is used to illustrate the reflective and formative models (Cassel 2006). Suppose that a doctor is examining a patient trying to decide or not whether the patient is ill, namely the doctor is trying to determinate the presence or absence of some disease. He/she can use two approaches:

- ask about different symptoms

- ask about possible causes of disease.

Different symptoms might be evaluated for example: body temperature, respiration rate, pulse rate, feelings of nausea, blood pressure or headaches. In contrast, the doctor might ask about whether the patient has been consuming a particular kind of food, about the patient's habits (drinking, smoking, sleeping, etc.), or any other pattern behaviour that might be causing the disease. Symptoms can be considered as reflective indicators because they reflect the disease; patterns of behaviour can be seen as formative indicators because they form (cause) the disease. The formative and reflective approaches to measure a latent construct are illustrated in Figure 4.4 through the disease example below (Cassel 2006).

Figure 4.4 Example of a latent variable measured by formative and reflective indicators



Source: Cassel (2006)

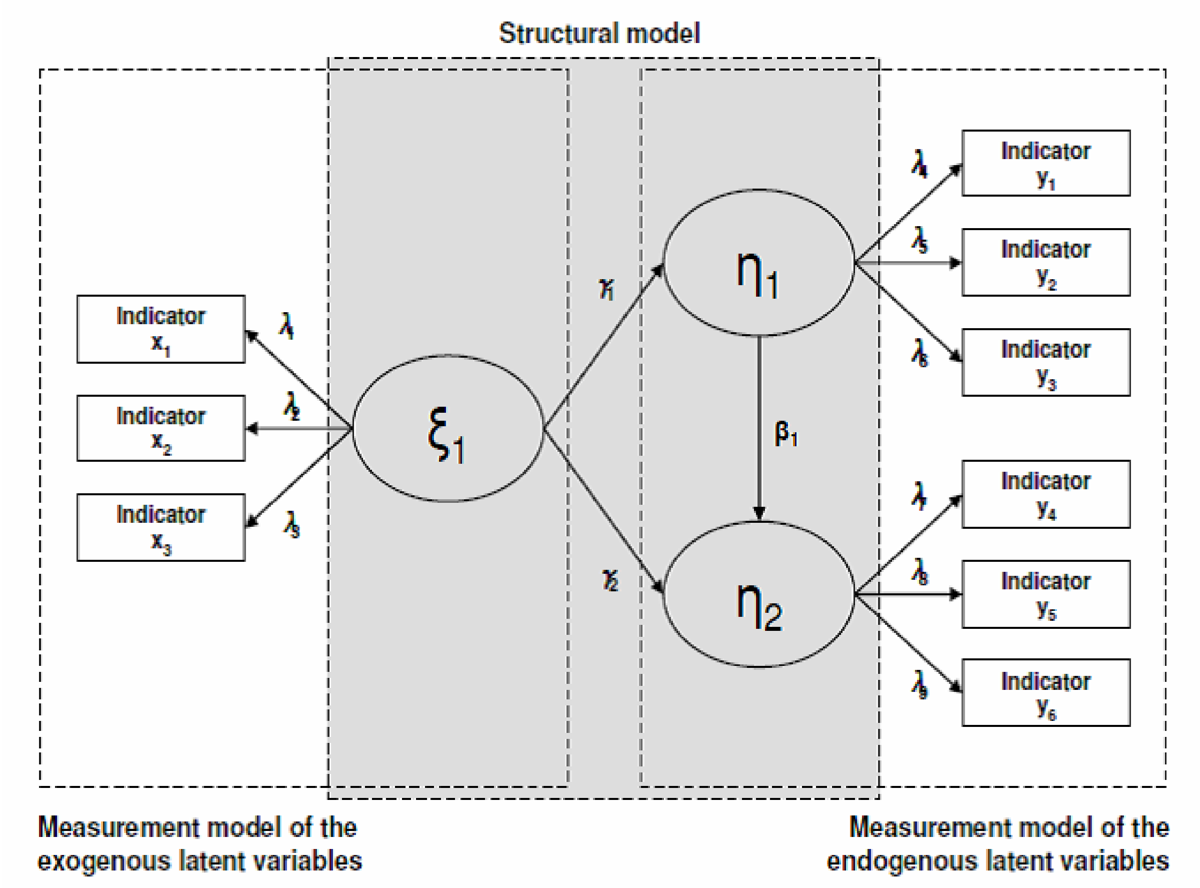
<u>Structural Equation Model</u>

Structural equation modeling can be used to estimate relationships among dependent latent variables and the relationships among latent constructs and the underlying observed variables (Holmes-Smith 2000). It is allowed in SEM that the observed indicators of the higher-order latent constructs are not available. It also comprehensively deals with reliability and validity measures (Barclay, Higgins &Thompson 1995).

A structural equation model consists of different sub-models. The structural model (or inner model) comprises the relationships between the LVs, which has to be derived from theoretical considerations. The independent LVs are also referred to as exogenous variables and the dependent LVs as endogenous variables. For each of the LVs within the structural equation model, a measurement model (or outer model) has to be defined. These models embody the relationship between the empirically observable indicator variables and the LVs. The measurement model itself needs to be grounded on an auxiliary theory. Blalock (1971) and, Edwards and Bagozzi (2000, p. 115) noted that, "without this auxiliary theory, the mapping of theoretic constructs onto empirical phenomena is ambiguous, and theories cannot be empirically tested."

The combination of structural model and measurement models leads to a complete structural equation model. An example of a simple model is illustrated in Figure 4.5. It consists of one exogenous (ξ_1) and two endogenous variables (η_1). The LVs are operationalised through the measurable indicator variables X_1 and Y_1. The relationships between the variables are quantified by path coefficients. The path coefficients λ_1 within the measurement models are either determined by weights—for formative constructs—or loadings—for reflective constructs. The path coefficients between latent endogenous variables are labelled β_1, whereas the path coefficients between exogenous and endogenous variables are referred to as γ_1. The primary statistical problem of analysing the structural equation model is the optimal estimation of the model's parameters as well as the determination of the model's goodness-of-fit to the sample data on the measured variables. SEM usually assumes that there are linear relationships between variables. If it does not adequately fit the data, the proposed model has to be rejected as a possible candidate for the observed variables' causal structure. However, the causal structure can be considered plausible if the model cannot be statistically rejected (Bentler 1980).

Figure 4.5 Example of a structural equation model



Source: Urbach & Ahlemann (2010)

<u>Path Modeling</u>

The term "path modelling" is a very generic term used to designate a set of different statistical techniques that seek to explain the relationships among multiple variables. Some examples of statistical methodologies considered as path modeling techniques are (Kline 2011):

- Path Analysis
- Exploratory Factor Analysis
- Confirmatory Factor Analysis
- Covariance Structure Analysis
- Linear Structural Relations
- Moments Structure Models.

All of them have two main characteristics in common: (1) the use of some prior knowledge (theory) about the relationships among variables, and (2) the graphical representation of those relationships by drawing a picture of the model following a well-established set of conventions.

The path modeling process starts at the conceptual level with a theoretical framework; a process that involves the establishment of the theoretical relationships among constructs. The subsequent step is deciding how many and which observed variables will be considered as indicators of the constructs (latent variables). The selection of manifest variables and their number is sometimes a subjective matter and no single criterion exists on this point. Regarding the number of indicators some authors like Bentler (1980) suggest to use as many indicators as possible, although having too many may present problems with model fitting.

The form most commonly used for relating each construct to its indicators is the reflective way, in which the construct is taken as a common factor (in the sense of factor analysis) of its indicators. Other times, however, constructs are related to its indicators through formative way, in which the constructs are taken as components or projections (in the sense of principal components analysis). Once the relationships of the model are fixed, they can be visualised in the form of a path diagram. The next step involves the mathematical specification of the model, that is, its translation into a system of equations, followed by the estimation phase and the validation of results.

In essence, Path Modeling is a methodology for the analysis of indirectly measured cause and effect relationships in complex behavioural systems. This analysis can be accomplished under two major approaches (Hulland et al. 1996) depending on the desired purposes:

- Confirmatory purposes
- Predictive purposes.

The confirmatory approach is concerned with theory development and testing by testing whether the assumed theory and hypotheses can be confirmed. The second approach, as its name implies, focuses on making predictions about the outcome variables of interest. The confirmatory option the model is analysed by examining the covariance structure of the data and testing probabilistic assumptions. The predictive option has to do with the variability of data in the form of a prediction model of the dependent variables.

The path modeling method for confirmatory purposes receives the generic name of Covariance Structure Analysis, also known as LISREL. In turn, the predictive oriented methodology is Partial Least Squares Path Modeling. However, due to a recent proposal of an alternative method to PLS-PM by Hwang and Takane (2004), the predictive oriented methodology is also referred to as component-based path modeling.

The confirmatory and the predictive oriented approaches imply different notions and protocols in the following aspects:

- Assumptions about data

- Links between latent variables and indicators
- Model specifications
- Estimation procedures
- Validation techniques.

Covariance Structure Analysis (CSA) seeks to determine the extent to which the postulated structure (the postulated theory) is actually consistent with the observed data. This involves performing hypotheses tests to evaluate how well the hypothesised model fits the data. The overall idea consists of calculating a theoretical covariance matrix implied by the specified model and comparing it to the actual covariance matrix based on the empirical data (Diamantopoulos 1994). To be precise, Covariance Structure Analysis seeks to minimise the difference between the empirical data covariance matrix and the theoretical covariance matrix deduced by the estimated parameters. The obtained model is used to explain the co-variability of the observed variables. In general, the CSA procedure assesses whether a sample covariance or correlation matrix is consistent with a hypothetical matrix implied by the model and specified by the researcher (Kumar & Deregowska 2002). Indeed, CSA is designed to maximise and test the degree of fit and consistency between the model and the data.

Partial Least Squares Path Modeling (PLS-PM) was originally developed as an analytical alternative to Covariance Structure Analysis for situations where the theory is weak and where the general assumptions of CSA are not met. The overall goal of PLS is to use observed independent variables to predict observed dependent variables. This is achieved indirectly by extracting independent and dependent latent variables from observed variables. This is done in such a way that they optimally address one or both of these two goals: explaining response variation and explaining predictor variation. The goal is to predict the dependent variables (both latent and manifest) by minimising the residual variances of the endogenous (i.e. dependent) variables. In particular, the method of partial least squares balances the two objectives, seeking latent variables that explain both response and predictor variation. (Kumar & Deregowska 2002).

Generalised Structured Component Analysis (GSCA) is an alternative method to PLS-PM and it has been recently developed by Hwang and Takane (2004). Because PLS-PM does not solve a global optimisation problem for parameter estimation, there is no single criterion minimised or maximised to estimate model parameters. To overcome this situation, Hwang and Takane (2004) proposed a new method that avoids the major drawbacks of PLS-PM.

4.6.2 Variance-Based Structural Equation Modeling: Partial Least Squares Path Modelling (PLS-PM)

Partial Least Squares Path Modeling (PLS-PM), also known as Structural Equation Modeling by the Partial Least Squares approach (PLS-SEM), is the integraion of two main concepts: (1) the concept of path modeling or structural equation modeling, and (2) the concept of partial least squares. PLS-SEM technique is a second generation multivariate data analysis tool (Barclay, Higgins & Thompson 1995; Chin 1998a; Chin & Newsted 1999). The PLS approach provides a general model which maps paths to many dependent variables and analyse all the paths simultaneously rather than one at a time (Barclay, Higgins & Thompson 1995; Fornell & Bookstein 1982; Gefen, Straub & Boudreau 2000). Although the concept of partial least squares appears later than that of structural equation modeling, its history and development can be seen as a process over a long period of time that covers many fields of knowledge such as biometrics, psychometrics, econometrics, and sociology, among others.

Partial Least Squares Path Modeling (PLS-PM) has become a research topic of enormous interest for many statisticians during the last decade. It has also been adopted as the preferred approach for structural equation modeling among an increasing number of researchers. As a result, PLS-PM has encountered a growing popularity across many disciplines and research areas such as education (Sellin 1995), sensory analysis (Pagès & Tenenhaus 2001), operations management (Brown & Chin, 2004; Raymond & St-Pierre 2005), information technology and systems (Mathieson et al. 2001), marketing (Hulland, Chow & Lam 1996; Jarvis, Mackenzie, Podsakoff, Mick & Bearden 2003; Hair, Sarstedt, Ringle & Mena 2012), human resources (Eskildsen et al. 2004; Bontis & Serenko 2007), and business management (Bontis 1998; Bart et al. 2001; Bontis 2004; Cabrita & Vaz 2006).

PLS-PM is a methodology of multivariate data analysis that allows for modeling complex cause-effect relationships involving latent (unobserved) and observed variables. Generally speaking, these models seek to analyse the underlying causal process that is assumed to generate some phenomenon of interest. PLS-PM was designed as a complementary technique to the covariance-based framework of SEM (Hair, Ringle & Sarstedt 2011). Currently, typical applications of PLS-PM can be found within marketing and management studies especially those related with customer satisfaction and other types of intangibles measurement. Particularly in marketing, the most typical application has to do with customer satisfaction measurement (Hackl & Westlund 2000; Martensen et al. 2000; Kristensen et al. 2001; Westlund et al. 2008; Vilares & Coelho 2003; Johnson et al. 2006). Today, Customer Satisfaction Marketing studies can be considered a landmark for PLS-PM as well as an experimental field, and is becoming the main developmental arena for a number of PLS contributions, proposals and innovations like those found in Cassel et al. (1999) and Eskildsen et al. (2005).

Traditionally, SEM approaches assume homogeneity over the entire set of observations without considering any group structure. However, this assumption is unrealistic in many cases; for example, in consumer behaviour research sources of heterogeneity can be due to customer age or gender (Chin 1998a). Analysts distinguish between two sources of heterogeneity: observed and unobserved. Heterogeneity is observed if it is possible to define segments based on an observed variable. Heterogeneity is unobserved when the variables that cause heterogeneity in the data are unknown beforehand. If population heterogeneity is not taken into account, conventional analysis may lead the analyst to inadequate results with a serious risk of drawing poor conclusions (Hahn, Johnson, Herrmann & Huber 2002; Sarstedt, Ringle & Schwaiger 2009).

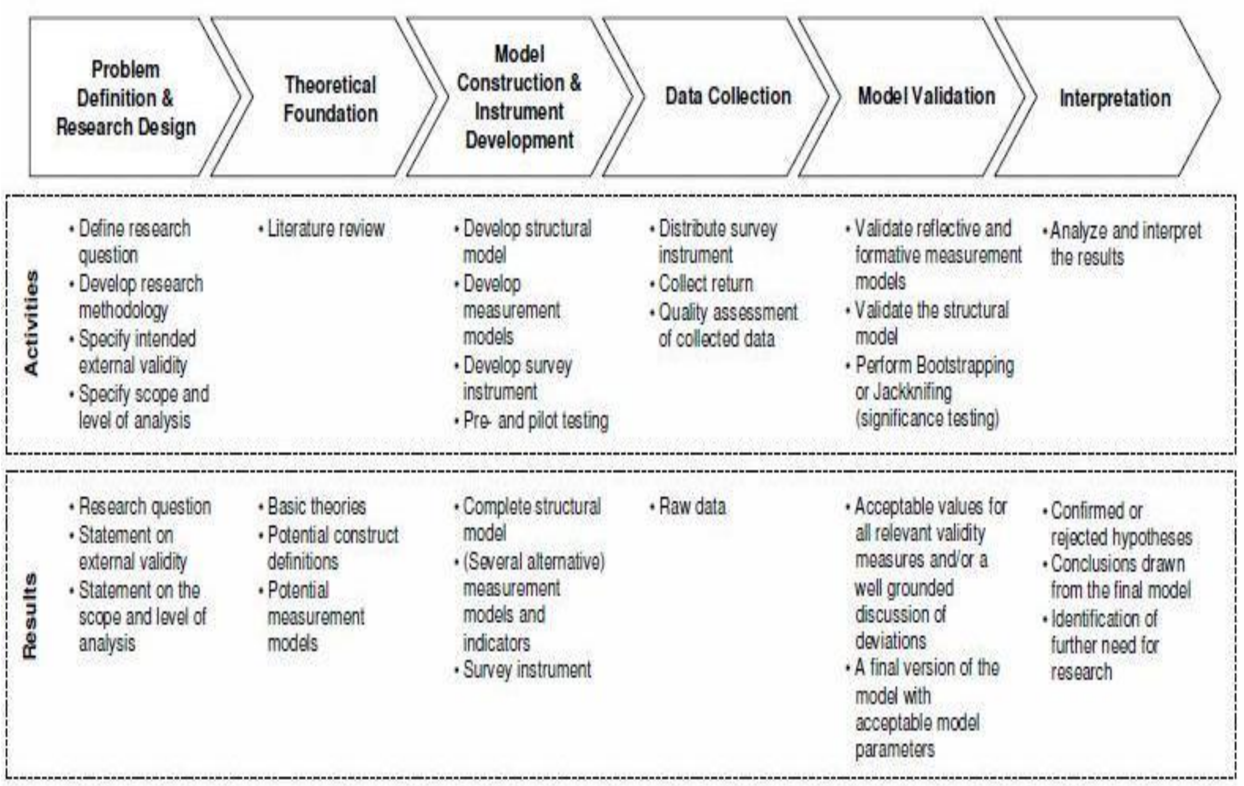
Framework for applying PLS-SEM

The concept of structural equations simply refers to the fact that the structure of cause-effect relationships between variables can be specified by a series of equations. In turn, the concept of path modeling refers to the graphical display of the structural equations in what is known as a path diagram. One of the main features of path modeling techniques is the ability to deal with latent variables. Simply stated, latent variables are hypothetical or theoretical variables that cannot be observed or measured directly. Because these types of variables cannot be measured explicitly, they have to be measured (or constructed) through variables that are perfectly observable/measurable.

Under PLS-SEM, it is assumed that all the measured variance is useful variance to be explained and the latent constructs are estimated as exact linear combinations of the observed measures. An overview is shown in Figure 4.6 for the typical SEM-based research by presenting a generic process model and pointing out the activities required within each process step and the results produced (Urbach & Ahlemann 2010). To make it more understandable, the model suggests a linear process flow. It should be clear that SEM studies are seldom that straightforward. However, this could be one limitation of PLS since so far no tools have been provided in PLS to deal with non-linear relations (Gefen, Straub & Boudreau 2000). Gefen, Straub and Boudreau (2000) also indicate that PLS has no established tools to overcome the issues of multi-collinearity, outliers, heteroscedasticity and polynomial relationships.

In many cases, researchers need to decide and return to previous steps in order to revise decisions made, either because intermediate results render this necessary or the researchers may want to compare alternative model variants or data analysis approaches. Besides the model validation phase, most of the framework's characteristics are not exclusively PLS-specific but applicable to SEM in general. More emphasis should be on the model validation phase because it is a critical step in the whole process (Urbach & Ahlemann 2010).

Figure 4.6 Framework for applying PLS in structural equation modelling



Source: Urbach & Ahlemann (2010)

4.6.2.1 Model Specification and Evaluation

The PLS model consists of two sequential stages: the measurement model and the structural model. The measurement model represents the relations between the manifest variables, i.e. independent variables, and the latent constructs, i.e. unobserved variables, which they represent. The structural model specifies the relationships among the latent constructs (Barclay, Higgins & Thompson 1995).

Where each unobserved latent construct in PLS is assigned a measurement range by constraining one of the paths from the latent construct to one of its indicator variables and assigning the value to this path to be 1.0. The remaining paths are thus estimated based on the constraint. The algorithm involved can be illustrated as the following two stages (Cool, Dierickxx & Jemison 1989). Firstly, the latent variables are assumed in an interactive manner to find a successive approximation. Alternations between the measurement and structural models are conducted where parameter estimates in either part of the model are treated as fixed as the parameters in the other part are estimated. Secondly, the measurement and structural convergence are presumed by regression using the latent variables estimated from the first stage (Cool, Dierickxx & Jemison 1989).

The PLS model is typically analysed and evaluated sequentially in two main steps (Barclay, Higgins & Thompson 1995; Hulland 1999). The first step is to assess each measurement model by examining individual item reliability, internal consistency and discriminant validity. The second step is to assess the structural model by performing the full SEM analysis. The detailed version of data analysis procedures and evaluation criteria in PLS have been outlined in Tables 4.6 (Hair, Ringle & Sarstedt 2011) while the simple version is consolidated in Table 4.7 from various sources (Barclay, Higgins & Thompson 1995; Hulland 1999; Quaddus 2004; Santosa, Wei & Chan 2005).

Table 4.6 PLS Data Analysis Procedures and Evaluation Criteria (Source: Hair, Ringle & Sarstedt 2011)

Reflective Measurement Models

- Internal consistency reliability: Composite reliability should be higher than 0.70 (in exploratory research, 0.60 to 0.70 is considered acceptable).
- Indicator reliability: Indicator loadings should be higher than 0.70.
- Convergent validity: The average variance extracted (AVE) should be higher than 0.50.
- Discriminant validity:
  - The AVE of each latent construct should higher than the construct's highest squared correlation with any other latent construct (Fornell–Larcker criterion).
  - An indicator's loadings should be higher than all of its cross loadings.

Formative Measurement Models

- Examine each indicator's weight (relative importance) and loading (absolute importance) and use bootstrapping to assess their significance. The minimum number of bootstrap samples is 5,000, and the number of cases should be equal to the number of observations in the original sample. Critical *t*-values for a two-tailed test are 1.65 (significance level = 10 percent), 1.96 (significance level = 5 percent), and 2.58 (significance level = 1 percent).
  - When all the indicator weights are significant, there is empirical support to keep all the indicators.
  - If both the weight and loading are nonsignificant, there is no empirical support to retain the indicator and its theoretical relevance should be questioned.
- Multicollinearity: Each indicator's variance inflation factor (VIF) value should be less than 5.
- Indicator weights should be examined to determine if they are affected by (observed or unobserved) heterogeneity, which results in significantly different group-specific coefficients. If theory supports the existence of alternative groups of data, carry out PLS-SEM multigroup or moderator analyses. If no theory or information is available about the underlying groups of data, an assessment of unobserved heterogeneity's existence must be conducted by means of the finite mixture PLS (FIMIX-PLS) method.
- When many indicators are used to measure a formative construct, with some being nonsignificant, establish two or more distinct constructs, provided there is theoretical support for this step.

Structural Model

- R^2 values of 0.75, 0.50, or 0.25 for endogenous latent variables in the structural model can be described as substantial, moderate, or weak, respectively.
- Use bootstrapping to assess the path coefficients' significance. The minimum number of bootstrap samples is 5,000, and the number of cases should be equal to the number of observations in the original sample. Critical *t*-values for a two-tailed test are 1.65 (significance level = 10 percent), 1.96 (significance level = 5 percent), and 2.58 (significance level = 1 percent).
- Predictive relevance: Use blindfolding to obtain cross-validated redundancy measures for each construct. Make sure the number of valid observations is not a multiple integer number of the omission distance *d*. Choose values of *d* between 5 and 10.
  Resulting Q^2 values of larger than zero indicate that the exogenous constructs have predictive relevance for the endogenous construct under consideration.
- Heterogeneity: If theory supports the existence of alternative groups of data, carry out PLS-SEM multigroup or moderator analyses. If no theory or information about the underlying groups of data is available, an assessment of unobserved heterogeneity's existence must be conducted by means of the FIMIX-PLS method, which is available in the SmartPLS software package.

Table 4.7 A simple version for PLS Data Analysis Procedures and Evaluation Criteria

Step 1: Assessing measurement models
I. Item Reliability: item loadings ≧ 0.7
II. Internal Consistency:
(i) composite reliability ≧ 0.7
(ii) AVE ≧ 0.5
III. Discriminant validity:
(i) Square root of AVE of a given construct > correlation between this construct and other constructs;
(ii) Item loadings of a construct > all other cross-item loadings of this construct
Step 2: Assessing the structural model
I. Collect the standardized path loadings
II. Test significance of the path loadings
III. Produce R-square values and their interpretation as in regression analysis
IV. Define the direct and indirect effects and their interpretation as in path analysis
V. Revise the model where it is feasible

Source: Adapted from Barclay, Higgins & Thompson (1995); Hulland (1999); Quaddus (2004); Santosa, Wei & Chan (2005)

Several procedures and methods with different measurement models are applied in order to evaluate the PLS outcome and its validity. Generally, PLS models are analysed and interpreted in two consecutive steps. First, the reliability and validity of the measurement model is assessed and then second, the structural model is assessed. By following this sequence, it can be assured that reliable and valid measures of constructs are used before the construct relationships are interpreted. Three methods for measurement model assessment are available (See Table 4.6). Tables 4.8, 4.9 and 4.10 show a breakdown of Table 4.6 in three parts in terms of reflective measurement models, formative measurement models and structural models (Urbach & Ahlemann 2010).

Table 4.8 Assessment of reflective measurement models

Validity Type	Criterion	Description	Literature
Unidimen-sionality	Exploratory factor analysis (EFA)	Measurement items should converge in the corresponding factor so that each item loads with a high coefficient on only one factor, and this factor is the same for all items that are supposed to measure it. The number of selected factors is determined by the numbers of factors with an Eigenvalue exceeding 1.0. An item loading is usually considered high if the loading coefficient is above .600 and considered low if the coefficient is below .400.	Gefen and Straub (2005), Gerbing and Anderson (1988)
Internal consistency reliability	Cronbach's alpha (CA)	Measures the degree to which the MVs load simultaneously when the LV increases. Alpha values ranges from 0 (completely unreliable) to 1 (perfectly reliable). Proposed threshold value for confirmative (explorative) research: CA > .800 or .900 (0.700). Values must not be lower than .600.	Cronbach (1951), Nunally and Bernstein (1994)
Internal consistency reliability	Composite reliability (CR)	Attempts to measure the sum of an LV's factor loadings relative to the sum of the factor loadings plus error variance. Leads to values between 0 (completely unreliable) and 1 (perfectly reliable). Alternative to Cronbach's Alpha, allows indicators to not be equally weighted. Proposed threshold value for confirmative (explorative) research: CA > .800 or .900 (0.700). Values must not be lower than .600.	Werts et al. (1974), Nunally and Bernstein (1994)
Indicator reliability	Indicator loadings	Measures how much of the indicators variance is explained by the corresponding LV. Values should be significant at the .050 level and higher than .700. For exploratory research designs, lower thresholds are acceptable. The significance can be tested using bootstrapping or jackknifing.	Chin (1998b)
Convergent validity	Average variance extracted (AVE)	Attempts to measure the amount of variance that an LV component captures from its indicators relative to the amount due to measurement error. Proposed threshold value: AVE > 0.500.	Fornell and Larcker (1981)
Discriminant validity	Cross-loadings	Cross-loadings are obtained by correlating the component scores of each latent variable with all other items. If the loading of each indicator is higher for its designated construct than for any of the other constructs, and each of the constructs loads highest with its own items, it can be inferred that the models' constructs differ sufficiently from one another.	Chin (1998b)
Discriminant validity	Fornell-Larcker criterion	Requires an LV to share more variance with its assigned indicators than with any other LV. Accordingly, the AVE of each LV should be greater than the LV's highest squared correlation with any other LV.	Fornell and Larcker (1981)

Source: Urbach & Ahlemann 2010

Table 4.8 summarises all the criteria that a reliable and valid reflective measurement model should meet. If this does not happen, the researcher may drop certain items from the measurement model and/or reallocate items to the structural model's LVs. In Table 4.9, the different criteria for assessing formative measurement models are summarised. However, in contrast to reflective measurement models, a subsequent modification of formative measurement models only on the basis of statistical outcomes is inadmissible. Discarding a formative model's item would omit a unique part of the composite latent construct and, thus, change the meaning of the variable (Jarvis et al. 2003). Accordingly, both significant and insignificant formative indicators should be kept in the measurement model as long as this is conceptually justified (Henseler et al. 2009). The different criteria for assessing a PLS model on the structural level are summarised in Table 4.10. Having confirmed the validity of the structural model, the results can be evaluated to test the research hypotheses.

Table 4.9 Assessment of formative measurement models

Validity Type	Criterion	Description	Literature
Indicator validity	Indicator weights	Significance at the .050 level suggests that an indicator is relevant for the construction of the formative index and, thus, demonstrates a sufficient level of validity. Some authors also recommend path coefficients greater than .100 or .200.	Chin (1998b), Lohmöller (1989)
Indicator validity	Variance inflation factor (VIF)	Indicates how much of an indicator's variance is explained by the other constructs' indicators and, thus, indicates how redundant the indicator's information is. Acceptable values are below 10.	Cassel and Hackl (2000), Diamanto-poulos and Siguaw (2006), Fornell and Bookstein (1982), Gujarati (2003)
Construct validity	Nomological validity	Means that, within a net of hypotheses, the formative construct behaves as expected. Relationships between the formative construct and other models' constructs, which have been sufficiently referred to in prior literature, should be strong and significant.	Henseler et al. (2009), Peter (1981), Straub et al. (2004)
Construct validity	Interconstruct correlations	If the correlations between the formative and all the other constructs are less than .700, the constructs differ sufficiently from one another.	Mackenzie et al. (2005), Bruhn et al. (2008)

Source: Urbach & Ahlemann 2010

Table 4.10 Assessment of the structural models

Validity Type	Criterion	Description	Literature
Model validity	Coefficient of determination (R^2)	Attempts to measure the explained variance of an LV relative to its total variance. Values of approximately .670 are considered substantial, values around .333 moderate, and values around .190 weak.	Chin (1998b), Ringle (2004)
Model validity	Path coefficients	Path coefficients between the LVs should be analyzed in terms of their algebraic sign, magnitude, and significance.	Huber et al. (2007)
Model validity	Effect size (f^2)	Measures if an independent LV has a substantial impact on a dependent LV. Values of .020, .150, .350 indicate the predictor variable's low, medium, or large effect in the structural model.	Cohen (1988), Chin (1998b), Ringle (2004)
Model validity	Predictive relevance (Q^2)	The Q^2 statistic is a measure of the predictive relevance of a block of manifest variables. A tested model has more predictive relevance the higher Q^2 is, and modifications to a model may be evaluated by comparing the Q^2 values. The proposed threshold value is $Q^2 > 0$. The predictive relevance's relative impact can be assessed by means of the measure q^2.	Stone (1974), Geisser (1975), Fornell and Cha (1994)

Source: Urbach & Ahlemann 2010

4.6.2.2 Assessment of Measurement Model

This stage is concerned with the relationships between the observed variables and the constructs (Chin 1998a). Items which represents the observed variables, measure the constructs. The analysis of the measurement model leads to the calculations of loadings that provide the researcher with an indication of the strength of the measures.

The assessment of measurement model stage concerns with the constructs validity or the extent to which the manifest indicators reflect their underlying constructs (Santosa, Wei & Chan 2005). In Table 4.11, the procedures follows the PLS framework on individual item reliability, internal consistency and discriminant validity to assess the adequacy of the measurement model (Hulland 1999; Barclay, Higgins & Thompson 1995; Quaddus 2004; Santosa, Wei & Chan 2005). Table 4.11 shows the 2-step procedures undertaken in stage 1 of measurement model assessment in this study and the following sections will discuss the details of the steps.

Table 4.11 Two-Step Assessment Procedure of Measurement Model

MEASUREMENT	ASSESSMENT PROCEDURE
1. Convergent Validity	
a) Item reliability	*Item loading ≥ 0.7*
b) Internal Consistency	
i. Composite Reliability	*Calculated value ≥ 0.7*
ii. Average Variance Extracted(AVE)	*Calculated value ≥ 0.5*
2. Discriminant Validity	
a) Construct level	*√ AVE of construct > correlation between the construct and other constructs*
b) Item level	*Item loadings of construct > all other cross-item loadings of the construct*

Source: Adopted from Hair, Ringle & Sarstedt (2011)

The first step of the assessment of measurement model is to test the convergent validity of the model. This is done by performing the following two steps:

a) Item Reliability

The first assessment property is the individual item reliability test. Individual item reliability examines the loadings of measures with their respective construct. This assessment refers to an analysis of estimating the amount of variance in each individual item's measure that is due to the construct (Barclay, Higgins & Thompson 1995).

PLS assessment procedure is conducted by conducting simple correlations of the measures with their respective construct. The calculated correlation leads to an item loading which gave an indication of the item's strength. Researchers have different opinion on the assessment of item loading's strength but the rule-of-thumb is that the higher the item loading, the better it would represent its constructs. Hair et al. (1998) provide guidelines for using item reliability to assess the relative significance of constructs and suggested three types of significance level for item loadings; (1) item loadings greater than 0.3 are considered significant (2) item loading greater than 0.4 are considered more significant (3) loadings in excess of 0.5 are considered very significant. In addition, Igbaria, Guimaraes and Davis (1995a) suggested 0.4 was an acceptable reliability limit.

However, the most frequently cited rule-of-thumb in the literature was given by Carmines and Zeller (1979), which suggests retaining only those items with loadings greater than or equal to 0.70. Generally, loadings higher than 0.7 are indicated. The rational of having higher item loading values is because items with lower loadings have a random error component that exceeds the explanatory component. By dropping the lower loading items would improve the item reliability and therefore would likely to lead to improving estimates of the true relationships between the constructs (Nunnaly 1978). However, often researchers find lower loadings. The ultimate threshold researchers suggest varies between 0.4 and 0.5. The higher the measure loadings, the lower the required number of indicators to explain a construct. In the case of formative indicators, the values correspond to simple correlations with the construct and no loadings can be established.

Thus, this study has taken a stance of having item reliability rules of 0.50, the value proposed by Hair et al. (1998). The more conservative of Hair et al.'s assessment's guidelines (1998) was chosen, to provide for more robust and reliable findings. This approach was considered more practical.

However, it is common to find a number of loadings below the acceptable threshold found in the literature. Items with extremely low loadings should be carefully analysed and reviewed especially in the case of strong theoretical rationale for including such items in the research model (Nunnaly 1978). Low loadings are attributed to several reasons such as incorrect wording in the questionnaire, using improper items to measure constructs or problems related to transferring questions from one context to another (Hulland 1999).

b) Internal Consistency

While item reliability refers to as a measure of items against its constructs, internal consistency is referred to as the measure of reliability of the constructs (Fornell & Larcker 1981). Many quantitative researchers had been using Cronbach's alpha as a measurement for internal consistency. Fornell and Larcker (1981) suggest two types of measurements for assessing internal consistency: (1) Composite Reliability (CR); (2) Average Variance Extracted (AVE).

The first measure developed by Fornell and Larcker (1981) uses composite reliability as the measure of internal consistency. The value of composite reliability can be calculated using the following formula (Chin 1998a; Barclay, Higgins & Thompson, 1995):

$$\rho c = \frac{(\sum \lambda i)^2}{(\Sigma \lambda i)^2 + \Sigma i \,\mathrm{Var}(\varepsilon i)}$$

where λi = the simple correlation between the item and its constructs (item loading) and Var (εi) = $1 - \lambda i^2$, the variance.

Convergent validity, also called composite reliability, measures the combined construct validity. Composite reliability is argued to be more superior than Cronbach's alpha. The claim is based on the argument that new measurement uses the item loadings obtained within the causal model (Barclay, Higgins & Thompson, 1995; Fornell & Larcker 1981). Since the measurement is not influenced by the number of items in the scale, thus the new measure is considered to be more general than Cronbach's alpha.

However, irrespective of which measure is used, the values are interpreted in the same manner in the research reports. A commonly used reliability measure is Cronbach's alpha. As with Cronbach's alpha, the benchmark of 0.7, which is considered to be a good threshold, is the minimum value for the calculated composite reliability (Nunnaly & Berstein 1994). It can be adopted to assess the internal consistency measure of the constructs (Barclay, Higgins & Thompson 1995).

The second measure suggested by Fornell and Larcker (1981) to assess internal consistency is concerned with assessing the Average Variance Extracted (AVE) for each construct. AVE indicates the amount of variance shared between a construct and its measures. Chin (1998) suggests that the value of AVE can be obtained using the formula below:

$$AVE = \frac{\Sigma \lambda i^2}{\Sigma \lambda\, i^2 + \Sigma \text{ Var } (\varepsilon\, i)}$$

where; λi = simple correlation between item and its constructs (item loading)
Var (εi) = $1 - \lambda\, i^2$ (the variance)

It is suggested that a construct should achieve a value greater than or equal to 0.5 in order to achieve adequate reliability (Barclay, Higgins & Thompson, 1995; Fornell & Larcker 1981; Nunnaly 1978).

Discriminant Validity

A third assessment property of measurement model is discriminant validity, which refers to the degree to which constructs differ with each other in the same model (Hulland 1999; Barclay, Higgins & Thompson 1995). The assessment of discriminant validity is carried out at both the construct and the indicator levels (Barclay, Higgins & Thompson 1995; Santosa, Wei & Chan 2005).

Discriminant validity measures how indicators of one construct differ from the indicators of other constructs in the same model, i.e. discriminate other constructs. It means that an item could potentially share more variance with other constructs than the construct it intends to measure. One criterion for discriminant validity is that the square root of average variance explained by a construct should be greater than the correlations among other constructs. The same can be achieved by comparing the average variance explained with the square of correlations between latent variables.

PLS technique normally assesses discriminant validity by examining the correlation at both constructs and items level. In order to meet the criteria for discriminant validity at construct level, the variance shared between measures of two different constructs should be lower than the AVE for the items measuring each construct (Fornell & Larcker 1981; Barclay, Higgins & Thompson 1995; Santosa, Wei & Chan 2005; Chin 1998).

The cross-loading analysis in PLS measures the correlation of an item with respect to all of the constructs in the model, including the construct it intends to measure (Chin 1998). An item should not load higher on other constructs than on the constructs it intends to measure; otherwise it should be excluded from the model.

4.6.2.3 Assessment of Structural Model

The structural model comprises the hypothesised relationships between latent constructs in the research model (Santosa, Wei & Chan 2005). In the structural model, it is required to specify the relationships of the constructs and their indicators, i.e.reflective or formative (Hulland 1999). PLS allows analysing the structural equation models with both reflective and formative constructs (Gefen, Straub & Boudreau 2000). The assessment of the structural model involves evaluating the explanatory power and the significance of the path coefficients (Barclay, Higgins & Thompson 1995; Santosa, Wei & Chan 2005).

The predictive power of the proposed research model can be assessed by obtaining the R^2 values (Barclay, Higgins & Thompson 1995; Santosa, Wei & Chan 2005). Interpreting the values of R^2 in PLS research models is the same as that in explaining the R^2 values produced by multiple regression analyses (Barclay, Higgins & Thompson 1995). Therefore, R^2 values will determine the explanatory power of a component of the model by indicating the amount of variance in the construct which is explained by its corresponding independent constructs (Barclay, Higgins & Thompson 1995).

The structural relationships are tested using the SEM approach, which is illustrated by 5-step procedure in Table 4.12. The predictive power of the proposed research model can be accessed by obtaining the R^2 values (Barclay, Higgins & Thompson 1995; Santosa, Wei & Chan 2005). Interpreting the values of R^2 in PLS model is the same as that in explain the R^2 values produced by multiple regression analyses (Barclay, Higgins & Thompson 1995). Therefore, R^2 values will determine the explanatory power of a component of the model by indicating the amount of variance in the construct which is explained by its corresponding independent constructs.

Table 4.12 A Five-Step Assessment Procedure of Structural Model

Step	Procedure
1	Collect standard path loadings
2	Test significance of path loadings
3	Produce R^2 values
4	Define direct and indirect effects
5	Revise the model where feasible

To test the significance of the structural paths in the model, the value and significance of the path coefficients are estimated using the bootstrapping method. Bootstrapping procedures, or the alternative, jackknifing approaches, are commonly used in PLS analyses (Chin 1998a). Using these non-parametric techniques allow the testing of the significance of parameter estimates from data which are not assumed to be multivariate normal in PLS (Barclay, Higgins & Thompson 1995; Chin 1998a). The choice between these two methods is based on a trade-off choice between computational time and efficiency (Chin 1998a). According to Chin (1998), the bootstrapping procedures, using a larger number of resamples, takes more time in computation than the jackknife estimation. Nevertheless, the bootstrapping method is more efficient than the jackknife since the latter is considered as an approximation to the bootstrap. Since the bootstrapping calculations are performed via utilising the SmartPLS version 2.0 software (Ringle, Wende & Will 2005), computational time is not considered to be an issue in this study. Accordingly, the more efficient method, bootstrapping, was adopted to assess the statistical significance of the structural paths in the research model.

4.6.3 Comparison of Covariance-Based Structural Equation Modeling (CBSEM) and PLS-PM

There are two types of SEM: covariance-based structural equation modeling (CBSEM) as implemented in LISREL, AMOS, EQS, SEPATH, and RAMONA and the component-based or variance-based approach partial least squares path modelling (PLS-PM) (Chin 1998a).

Covariance-based Structural Equation Modeling (CBSEM) is also known as Covariance Structure Analysis (CSA) which has been mainly developed by Karl Jöreskog (1973). CSA (Long 1983; Bollen 1989) is usually employed for hypothesis testing and model validation. Component-based SEM is comprised of Partial Least Squares Path Modeling and Generalised Structured Component Analysis (GSCA).

These approaches differ in their analyses' objectives, their underlying statistical assumptions, and the nature of the fit statistics they produce (Gefen et al. 2000). CBSEM are best suited to theory-oriented confirmatory analysis, while PLS-PM is primarily intended for predictive analysis in situations of high complexity with less strict statistical assumptions (Wold 1982; Chin 1998). In statistical terminology, CBSEM typically uses a maximum likelihood (ML) function to minimise the difference between the sample covariance and those predicted by the theoretical model. Consequently, the estimated parameters attempt to reproduce the observed values' covariance matrix. If the ML function is applied, the observed variables have to follow a normal distribution. In contrast, the PLS algorithm minimises the variance of all the dependent variables instead of explaining the co-variation. Consequently, PLS makes lower demands on measurement scales, sample size, and residual distributions (Wold 1985). CBSEM requires multivariate normality, whilst PLS is "distribution free" (Wold 1982). In co-variance based SEM it is assumed that measures have random error, while in PLS it is assumed that observed variances are useful (Anderson & Gerbing 1988). Information estimation in co-variances SEM is more efficient than in PLS (Fornell & Bookstein 1982). PLS is better suited to more complex models with smaller sample sizes (Fornell & Bookstein 1982; Wold 1982; Chin 1998a). In addition, PLS-PM avoids inadmissible solutions and factor indeterminacy (Fornell & Bookstein 1982). Table 4.13 summarises the characteristics of the PLS approach and compares it with CBSEM (Urbach & Ahlemann 2010). Table 4.14 provides the selective criteria for choosing between CB-SEM and PLS-SEM (Hair, Ringle & Sarstedt 2011)

Table 4.13 Comparison of PLS-PM and CBSEM

Criteria	PLS	CBSEM
Objective	Prediction-oriented	Parameter-oriented
Approach	Variance-based	Covariance-based
Assumption	Predictor specification (nonparametric)	Typically multivariate normal distribution and independent observations (parametric)
Parameter estimates	Consistent as indicators and sample size increase (i.e., consistency at large)	Consistent
Latent variable scores	Explicitly estimated	Indeterminate
Epistemic relationship between an LV and its measures	Can be modeled in either formative or reflective mode	Typically only with reflective indicators. However, the formative mode is also supported.
Implications	Optimal for prediction accuracy	Optimal for parameter accuracy
Model complexity	Large complexity (e.g., 100 constructs and 1,000 indicators)	Small to moderate complexity (e.g., less than 100 indicators)
Sample size	Power analysis based on the portion of the model with the largest number of predictors. Minimal recommendations range from 30 to 100 cases.	Ideally based on power analysis of specific model—minimal recommendations range from 200 to 800.
Type of optimization	Locally iterative	Globally iterative
Significance tests	Only by means of simulations; restricted validity	Available
Availability of global Goodness of Fit (GoF) metrics	Are currently being developed and discussed	Established GoF metrics available

Source: Urbach & Ahlemann (2010)

Table 4.14 Selection criteria for choosing CB-SEM or PLS-SEM (Source: Hair, Ringle & Sarstedt 2011)

Research Goals

- If the goal is predicting key target constructs or identifying key "driver" constructs, select PLS-SEM.
- If the goal is theory testing, theory confirmation, or comparison of alternative theories, select CB-SEM.
- If the research is exploratory or an extension of an existing structural theory, select PLS-SEM.

Measurement Model Specification

- If formative constructs are part of the structural model, select PLS-SEM.
  Note that formative measures can also be used with CB-SEM but to do so requires accounting for relatively complex and limiting specification rules.
- If error terms require additional specification, such as covariation, select CB-SEM.

Structural Model

- If the structural model is complex (many constructs and many indicators), select PLS-SEM.
- If the model is nonrecursive, select CB-SEM.

Data Characteristics and Algorithm

- If your data meet the CB-SEM assumptions exactly, for example, with respect to the minimum sample size and the distributional assumptions, select CB-SEM; otherwise, PLS-SEM is a good approximation of CB-SEM results.
- *Sample size considerations:*
  - If the sample size is relatively low, select PLS-SEM. With large data sets, CB-SEM and PLS-SEM results are similar, provided that a large number of indicator variables are used to measure the latent constructs (consistency at large).
  - PLS-SEM minimum sample size should be equal to the larger of the following: (1) ten times the largest number of formative indicators used to measure one construct or (2) ten times the largest number of structural paths directed at a particular latent construct in the structural model.
- If the data are to some extent nonnormal, use PLS-SEM; otherwise, under normal data conditions, CB-SEM and PLS-SEM results are highly similar, with CB-SEM providing slightly more precise model estimates.
- If CB-SEM requirements cannot be met (e.g., model specification, identification, nonconvergence, data distributional assumptions), use PLS-SEM as a good approximation of CB-SEM results.
- CB-SEM and PLS-SEM results should be similar. If not, check the model specification to ensure that CB-SEM was appropriately applied. If not, PLS-SEM results are a good approximation of CB-SEM results.

Model Evaluation

- If you need to use latent variable scores in subsequent analyses, PLS-SEM is the best approach.
- If your research requires a global goodness-of-fit criterion, then CB-SEM is the preferred approach.
- If you need to test for measurement model invariance, use CB-SEM.

4.6.4 Application of PLS-PM for the Purpose of This Research

PLS-SEM is particularly useful for analysing complex models having a small sample size. Compared to other commonly-used structural equation models like structural covariance analysis (the technique used by programs such as LISREL and AMOS), PLS requires fewer constraints and assumptions. Similar to regression and analysis of variance, structural covariance analysis demands two critical assumptions, namely: independence of causal variables and normality of all variables (Chin, Marcelin & Newsted 2003). Since these assumptions require data sets having large number of observations, this approach is not applicable to many data sets. In contrast, in PLS, the number of variables can even be greater than the number of observations (Wold 1985; Tenenhaus et al. 2005, p. 202). A rule-of-thumb for PLS modeling suggests that the sample size should be equal to the larger of the following (Chin, 1998):

- Ten times the number of indicators of the scale with the largest number of formative indicators, or
- Ten times the largest number of structural paths directed at a particular construct in the inner path model.

Chin and Newsted (1999) illustrate a Monte Carlo simulation on PLS with small sample sizes and show that the PLS approach can even work well at sample sizes as low as twenty.

Besides the application of PLS to the social sciences, PLS has also developed in the natural (applied) sciences. Unlike the causal modeling technique of PLS in the social sciences, studies in the natural sciences are aimed at predictive modeling (Linton 2004). Furthermore, different sets of tools and techniques are developed in the applied sciences to predict and solve non-linear problems that are uncommon in the social sciences. Further discussion on the non-linear aspect of the PLS method will not be provided, since this study implements purely linear PLS.

Having considered the background of PLS and its advantages over other SEM approaches, the following sections will examine two different versions of PLS, namely, the causal and predictive modeling approaches. The literature review will also identify SCM studies that implement the PLS approach.

PLS is a powerful method, since it places minimal demands on sample size, residual distributions, and measurement scales (Chin et al. 2003). The following list highlights reasons why the PLS approach is superior to other covariance-based methods:

1. Assumptions: Unlike any other data analytic methods, PLS is non-parametric, meaning that it does not have any assumptions on the nature of the distribution of data. PLS can handle data that do not satisfy the normality assumption. This flexibility is one of the major advantages of PLS over other methods. Furthermore, PLS does not assume independence between predictor variables. Independence assumption can be problematic particularly in other data analytic methods, where the modeler can wrongfully assume independence even if predictor variables are correlated with each other.

2. Structural Equation Model: As discussed previously, PLS models include both latent and manifest variables. PLS can utilise multiple dependent variables. This ability allows PLS to model real systems. In addition, PLS does not place stringent rules on the minimum sample size. For example, while covariance based structural equation models like LISREL requires a minimum sample size of 100 – 200 for any model (Chin et al. 2003), the block modeling approach of PLS allows smaller data sets as low as thirty observations. The sample size requirement of other SEM techniques increases as the number of interaction term indicators due to the number

of parameters being estimated. Because the minimum sample size is not determined by the number of relations and variables in the model, the sample size requirement is dictated by the largest (most complex) block under consideration (Chin et al. 2003; Linton 2004). Furthermore, standard error estimation techniques (i.e. bootstrapping and jackknifing) can be used to test the statistical significance of the model even if the small sample size is small.

3. Types of indicators: PLS is compatible with both reflective and formative constructs. This strength is particularly useful to analyse complex systems that include both reflective and formative construct. This is in fact the case in numerous complex supply chains.

Even though most articles covered in this study implemented PLS for theory testing, this method can also be used to suggest propositions where relationships do or do not exist (Chin et al. 2003). In fact, Fornell and Bookstein (1982) underline that unlike alternative covariance fitting approaches (i.e. LISREL and AMOS), PLS avoids two critical problems, namely: inadmissible solutions and factor indeterminacy. If prior theory is strong, and the goal is to test and develop the theory further, full-information estimation methods, such as Maximum Likelihood, are more suitable. However, as a result of the factor score estimation indeterminacy, covariance-based methods do experience a loss of predictive accuracy (Chin et al. 2003).

The PLS approach is also suitable for application and prediction as in Principal Component Analysis (PCA) (Wold 1982; Chin et al. 2003). PLS overcomes the factor indeterminacy problem, since it provides exact component scores by estimating latent variables from the linear combinations of observed measures (Wold 1982). Furthermore, since the PLS method uses an iterative algorithm by implementing a series of least squares analyses, this approach does not need to presume any distributional form (i.e. normality assumption) unlike other covariance-based methods. Chin et al. (2003) also note that this allows smaller sample size, where sample size should be greater than or equal to ten times the number of indicators for the scale having the largest number of formative indicators that scales for constructs designated with reflective indicators. Finally, studies show that the PLS method is powerful for explaining complex relationships (Fornell & Bookstein 1982; Wold 1982; Chin et al. 2003).

In addition, Chin (1998) also provided three situations in which PLS is more appropriate than co-variance SEM. Based on these, PLS is proposed to be the more appropriate data analysis approach for this study:

1) PLS is more appropriate if the research phenomena are relatively new, such that the theoretical model or measures are not yet well formed, thus requiring flexibility in the modelling stage. In this study, the budgeting systems style of use construct is being measured with a new set of scales and structural model configuration, thus potentially requiring flexibility during the data analysis stage for eliciting the optimal measurement approach. In addition, the market competitiveness construct has not been operationalised previously.
2) PLS is more appropriate when the data conditions relating to normal distribution, independence, or sample size are not met. In particular, in this study the number of responses from firms in hypercompetitive settings is expected to be relatively small, and PLS is particularly suited to small sample sizes (Chin and Newsted 1999).
3) PLS is more appropriate when the model is relatively complex, with a large number of measures or constructs. In this study, the proposed model contains second-order constructs with a large number of measures.

In summary, there has been increased use of PLS among researchers lately due to the ability of PLS to model latent constructs under conditions of non-normality and small to medium sample sizes (Barclay, Higgins & Thompson 1995). Besides, PLS is suggested to be more suited when the measures are not well established or are used within a new measurement (Barclay, Higgins & Thompson 1995). Since the existing literature is deficient in providing a comprehensive research model for investigating the relationship among environmental dynamism, entrepreneurial types, entrepreneurial leadership capacity framework and entrepreneurial process model, the final research model proposed in this study is not based on a "solid" theory and is regarded as an estimate model that combines relevant theories and previous empirical research results. Therefore, the focus of this research is more on prediction applications and theory building, rather than testing the fit of a strong theory-based model. With the arguments stated above, PLS is considered appropriate for the current study as the main survey data analysis technique.

In the statistical analysis of this study, SmartPLS version 2.0 software (Ringle et al. 2005) will be used to perform PLS-SEM.