

**NATURE, EXTENT AND ANTECEDENTS OF RISK MANAGEMENT PRACTICES
IN KNOWLEDGE-INTENSIVE FIRMS**

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Abstract

This study provides empirical evidence on the nature and extent of risks faced by Small to Medium-Sized Knowledge Intensive Firms (SMKIFs) and the risk management approaches adopted by them. The study also assesses the effects of selected organisational factors such as industry, entity size and risk governance leadership on the commitment by SMKIFs to using an Enterprise Risk Management (ERM) approach. Data was obtained through a questionnaire survey of SMKIFs in the state of Victoria, Australia which were either in the bio-technology (bio-tech) or the accounting and legal (business services) industry sectors. Based on a total of 104 (13%) useable responses from senior managers in charge of risk management, some of the key findings include the identification of the top three risks faced by SMKIFs being (i) potential damage to firm's reputation, (ii) inability to recruit and retain workers who have appropriate skills and expertise, and (iii) increase in costs. Interestingly, while 51% of the respondents described their firms as being willing to or keen to take risks, 38% saw their firms as being either preferring not to take risks or refuse to take risks, with the remainder of the firms (11%) viewed as neutral. The data also indicates that more than half of the respondent firms (54%) had established either a complete or a partial ERM system. Further, data analysis based on a binary logit regression model indicates bio-techs, firm size and directors' support of risk management as key predictors of ERM implementation in SMKIFs.

Key Words

Corporate Governance, Enterprise Risk Management, Knowledge-Intensive, Bio-Tech

1. INTRODUCTION

There is heightened awareness and increasing calls for effective risk management in organisations. The recent 2008 financial market crisis, expanding climate change imperatives, continuing large corporate failures, and growing stakeholder demands for better corporate governance are some of the key factors that underscore the importance of risk management for many an organisation. Arguably, the need for effective risk management systems is felt most acutely by knowledge intensive organisations because they tend to operate in highly dynamic and volatile environments with much of their assets in intellectual capital form. Knowledge intensive firms are seen as distinct from labour or capital intensive firms due to their high reliance on the professional knowledge of individuals, and they tend to operate in a range of industries including research and development (R&D), bio-technology and business services (e.g. computer, legal, management and accountancy). In Australia, many of the knowledge intensive firms tend to be small or medium-sized enterprises. Nevertheless, these small or medium-sized knowledge intensive firms (SMKIFs) are in particular acknowledged as an important source of national knowledge-based wealth creation in that they have the potential to develop innovative products and services that are akin to internationalisation and export (NOUS-DIIRD, 2007).

However, the failure rate of SMKIFs is generally high. During the initial years, many SMKIFs run at a financial loss dealing with considerable uncertainty. In particular, those in the scientific and technological industries are focused on creation of innovative assets leading to patents, and their investments can take long periods of incubation and testing. To survive during these years, SMKIFs need to identify and plan for various key business risks – both downside risks (losses) as well as upside risks or gains (exploiting opportunities). An effective and efficient risk management system should enable them to create and exploit knowledge as a source of competitive advantage and adapt to new environments more

successfully (Kuivalainen et al, 2004). Bekefi et al. (2008), in fact, argue that “by focusing on the downside of risk, companies can overlook opportunities that provide significant possibilities for organisational innovation and new competitive advantage” p.72. They further argue that assessing and subsequently altering an organisation’s risk appetite is a first step in managing opportunities related to various business and organisational risks. To date, there is little empirical evidence on the nature, extent and antecedents to risk management within SMKIFs. No doubt, a better understanding of the factors affecting risk management practices within SMKIFs will have direct implications for enhancing their organisational performance, and in many cases even survival of such entities.

The objectives of this paper are two-fold. First, we aim to provide empirical evidence on the nature and extent of risks faced by SMKIFs, their attitudes towards risks, and the risk management approaches adopted by them. Second, we also aim to assess the effects of selected organisational factors such as industry, entity size and risk governance leadership on the commitment by SMKIFs to adopt an Enterprise Risk Management (ERM) approach. ERM involves undertaking an organisation-wide perspective to risk management (instead of the silo-based traditional approach), and it has been strongly advocated as a more effective approach in managing risks in business organisations (COSO, 2004). However, ERM is still an evolving concept and is expected to entail considerable coordination and leadership within organisations.

Data for this study was obtained through a questionnaire survey of SMKIFs in Victoria which are either in the bio-tech or the business service industry sectors (accounting and legal services). Questionnaires were addressed to senior managers (chief financial officer or chief risk officer) with overall responsibility for risk management, and a total of 104 (13%) useable responses were received from a mail-out of 818 questionnaires. Some of the key findings are as follows. Firstly, the top three risks faced by SMKIFs are (i) the potential

damage to the firm's reputation, (ii) inability to recruit and retain workers who have appropriate skills and expertise, and (iii) increase in costs. Legislation/regulatory bodies (i.e. compliance), competitive business environment (business imperatives), and top executive management were viewed as the top three drivers of risk management in SMKIFs. Interestingly, while 51% of the respondents described their firms as being willing to or keen to take risks, 38% were seen to either preferring not to take risks or refuse to take risks, with the remainder (11%) viewed as neutral. The data also indicates that more than half of the respondent firms (54%) had established either a complete or a partial ERM system. Further, data analysis based on a binary logistic model identified industry sector (bio-tech firms), firm size, and directors' support or push for risk management as key drivers of SMKIFs' implementation of ERM. Contrary to what was expected, organisational risk stance did not predict the level of the ERM implementation.

The remainder of the paper is organised as follows: The next section i.e. Section 2 reviews the relevant literature and develops several research questions and hypotheses. Section 3 describes the research method. Findings of the study are presented in Section 4. Section 5 contains the discussion of results, conclusions and directions for future research.

2. LITERATURE REVIEW AND RESEARCH QUESTIONS

2.1 Nature of Risks, Risk Management Attitudes and Methods

The concept of risk refers to the probability of specific eventualities, and such eventualities may have both beneficial and adverse consequences. Risks can be objective and measurable (i.e. probabilities can be assigned to eventualities based on systematic scientific techniques) or be subjective and based on perceptions (i.e. based on intuition and hindsight).

From a business perspective, “risk management is the process by which organisations methodically address the risks attaching to their activities in pursuit of organisational objectives and across the portfolio of all their activities” (Collier, Berry and Burke, 2007, p. xvii). Generally, business risks can be classified in a variety of ways, and a common typology is as follows:

- 1) Financial risk – relating to the financial aspects/operations of a business e.g. liquidity risk, gearing risk, foreign exchange risk, etc.,
- 2) Business or Operational risk – pertains to the business operations and activities carried out within an organisation which may include fraud risk, legal risk, supply-chain risk, etc.,
- 3) Environmental risk – refers to a variety of social, economic, political and physical environmental risks,
- 4) Reputation risk – relates to the loss of an organisation’s standing and trustworthiness in the public’s eye.

Many of the business-related risks are common to both knowledge intensive firms as well as conventional capital-intensive or labour-intensive firms. However, the characteristics that more uniquely define SMKIFs may elevate certain types of risks more than others. For example, it is expected that SMKIFs tend to rely on employees with critical skills and aptitude, and loss of such staff is likely to be a major risk for maintaining competitive advantage (Cohen and Levinthal, 1990). Further, Swart and Kinnie (2002) also highlight that knowledge intensive firms tend to have a different growth pattern to more traditional firms in that they tend to grow fast, particularly in terms of employees. Consequently, where full-time employees are not available, such firms also tend to rely on sub-contractors or other types of

outsourced arrangements to meet their human resource needs. This in turn raises another type of risk i.e. outsourcing risks which relate to hiring competent and reliable service providers.

Further, Anderson (2008) argues that knowledge intensive firms own mostly firm-specific, intellectual-based assets which are hard to be traded in the market. It is generally difficult to protect the ownership of intellectual-based assets due to rampant copyright and patent violations. In the event of distress or failure, these assets may end up with no value at all. Furthermore, most SMKIFs tend to be unlisted in stock exchanges, and thus they are likely to face greater risk of financial distress in the event of withdrawal of commitment and financial support by a partner.

While the variety of risks faced by SMKIFs may be wide ranging, the propensity to take risks and the attitudes of managers and organisations in addressing their business risks could differ. Collier et al. (2007) found in their survey of 242 management accountants (all members of CIMA), and 91 directors (50 from the top FTSE firms and 41 from small to medium enterprises (SMEs) in UK) that the propensity to take risks was higher in larger firms than in the SMEs. Further they also found that more respondents agreed that risk management in their organisation was about avoiding negative consequences (79%) than about achieving positive outcomes (57%). However, managers' responses in relation to their personal views on risk management is that it is as much about achieving positive consequences as it is about avoiding negative outcomes. Such a finding indicates that organisations tend to take a more defensive stance than individual managers in terms of managing risks. However, Collier et al.'s (2007) sample did not distinguish between knowledge intensive and the other types of firms.

Firms adopt various risk management methods for identifying, assessing, evaluating and treating risks. These methods may vary on the dimensions of sophistication (basic to sophisticated analysis) and quantification (qualitative to quantitative). Further, while the use

of interviews, brainstorming, scenario analysis and likelihood matrices are more basic methods of risk management; statistical modeling, statistical analysis, and risk management software usage are viewed to be more technical and sophisticated. Interestingly, Collier et al. (2007, p. 11) found that the use of more subjective methods intuition, hindsight and judgment was the most common, followed by the use of external risk consultants and basic methods. Technical methods were the least commonly used for risk management.

In summary, based on the above discussion, the main research questions of interest for this study are as follows:

- 1) What are the different types of risk faced by SMKIFs in Victoria, and how are these ranked?
- 2) What is the general risk attitude within these SMKIFs i.e. being risk averse or being risk-takers, and is risk management about avoiding negative consequences or achieving positive outcomes?
- 3) What are the common risk management approaches and mechanisms adopted in SMKIFs?
- 4) Is there a difference in the risk planning, and risk management structures and approaches between technology-oriented SMKIFs (e.g., bio-tech) and business service-focused SMKIFs (e.g., accounting and financial services)?

2.2 Risk Management Approaches and Enterprise Risk Management

In recent years, an organisation-wide approach to managing risks, also known as Enterprise Risk Management (ERM) has been strongly advocated as a more holistic and effective approach for managing risks in business organisations. The Committee of Sponsoring Organisation's (COSO) "Enterprise Risk Management-Integrated Framework" published in 2004 defines ERM as:

A process, effected by an entity's board of directors, management, and other personnel, applied in strategy setting and across the enterprise, designed to identify

potential events that may affect the entity, and manage risk to be within its risk appetite, to provide reasonable assurance regarding the achievement of entity objectives.

Thus, ERM is seen to provide a framework where a top-down approach is adopted, and a systematic identification of particular events or circumstances relevant to the entity's objectives is undertaken. This is followed by an assessment of their likelihood and the magnitude of their individual and joint impact on entity's objectives and the development of a strategy to monitor and mitigate the identified risks. ERM has emerged as a new paradigm for managing the portfolio of risks faced by organisations (Beasley et al, 2005). Being a holistic and an enterprise-wide approach, it is viewed as an effective way to manage the myriad of interrelated risks that face organisations (Stoh, 2005). The main difference between ERM and traditional ways of managing risk is that ERM involves a high-level oversight of a firm's entire risk portfolio rather than managing specific risks in a segregated 'silo' manner (Banham, 2004). Furthermore, it has been argued that ERM helps avoid losses or left-tail outcomes (Nocco and Stultz, 2006) and therefore may be beneficial to SMKIFs as they face high probabilities of losses which potentially lead to business failure (e.g. financial distress, bankruptcy).

ERM can also be a significant source of competitive advantage for those who make a strong commitment to it as it focuses on upside risks as well (Stoch, 2005; Beasley et al, 2005). As an ERM approach is more holistic, taking into consideration the inter-related nature of risks, for example, by lowering cash flow risks, they may be able to attract better funding which in turn may improve their productive capacity and lower the risk of product innovation failure. However, to date there has been no systematic, large scale study undertaken to determine the key antecedents to the commitment to ERM implementation in SMKIFs.

2.3 Factors affecting commitment to ERM by firms

Several prior studies in recent years focused on understanding the evolution and the determinants of ERM implementation, namely Colquitt, Hoyt and Lee (1999), Kleffner, Lee and McGannon (2003), Liebenberg and Hoyt (2003), Beasley et al. (2005) and Pagach and Warr (2008). Most of these studies involved questionnaire surveys and in some cases annual report analysis for data collection. Colquitt et al. (1999) based on a survey of 1,931 US firms provided largely descriptive data on the use of integrated risk management systems, existence of separate financial risk management departments, and appointment of chief risk officers. The study also signalled that given that the use of an integrated risk management system was more common in certain industries e.g. insurance and finance companies, industry may be a key factor in the uptake of ERM. Kleffner et al. (2003) explored the implementation of ERM in Canadian firms, and based on survey data from 118 firms, identified industry to be a significant factor in ERM implementation. The study by Liebenberg and Hoyt (2003) assessed ERM adoption in relation to firms' financial characteristics e.g. higher earnings volatility, stock price volatility, growth opportunities, leverage and institutional share ownership. Using data from 26 paired samples from the pool of all US firms that announced the appointment of a CRO between 1997 and 2001, they found only one significant result – that is more highly leveraged firms tend to implement ERM.

More recently, Beasley et al. (2005) based on survey data from 123 US and international firms found that ERM implementation is significantly related to CEO and CFO support for ERM, firm size and industry affiliation i.e. banking, education and insurance. Finally, Pagach and Warr (2008) extended Liebenberg and Hoyt's (2003) study by examining data from a larger sample i.e. 138 companies, and extended the range of variables studied by including stock and option holdings of managers. Their findings suggest significant and

positive associations between firm size, leverage, higher institutional holdings and firms in financial and utilities industries and ERM adoption, and significant and negative association between the number of segments and ERM adoption.

However, both Liebenberg and Hoyt (2003) and Pagach and Warr (2008) used a fairly crude measure of ERM adoption, that is the appointment of a Chief Risk Officer (CRO) is assumed to reflect ERM adoption. Beasley et al. (2005) however used a 5-point scale, representing different stages of ERM implementation: full implementation, partial implementation, in the planning process of implementation, thinking / assessing the possibility of implementing ERM, and do not intend to implement ERM. Furthermore, none of the prior studies had distinguished firms that are knowledge intensive in their data analysis.

For our study, we use an adaptation of Beasley et al's (2005) measurement scale, and specifically focus on whether firms had adopted ERM or not. In this way we distinguish firms that have committed to ERM and those that have not. We develop in the following sections four specific hypotheses relating to the impact of selected organisational factors (i.e. industry sector, firm size, support of ERM by directors and organisational risk attitude) as predictors of the level of commitment to ERM in SMKIFs.

2.3.1 Industry Sector

Industry sectors vary in their history and the level of business risks. Financial institutions, particularly banks have been leaders in the adoption of ERM as a result of regulatory pressures on capital requirements e.g. Basel II (2004). Beasley et al. (2005) found that the adoption of ERM was higher in the banking, education, and insurance industry sectors than in the other industry sectors. It was argued that educational institutions and insurers were also open to greater regulatory scrutiny and have been encouraged to implement ERM (Whitfield, 2004).

In this study, we focus on two broad sectors under which SMKIFs can be classified - bio-tech and business services. Bio-tech firms are in the scientific and technological industries, and they are generally focused on creation of innovative assets leading to patents. As such, they tend to face high risk and uncertainty as their investments can take long periods of incubation and testing. Proper planning for various key business risks – both downside risks (losses) as well as upside risks (exploiting opportunities) is likely to aid survival. In particular, unexpected delays in technology that help breakthrough of ideas, the risk of significant increase in costs, and financial risks are all inter-related and will need concurrent considerations. Consequently, there would be greater willingness in bio-tech firms to invest in an ERM approach to risk where risks can be more wholly managed.

By contrast, business service firms tend to face lower business risks as they deal with more routinised work processes. For example, accounting and legal firms have standard work practices guided by professional standards. Furthermore, most professionals in such firms are likely to hold professional indemnity insurance and having more sophisticated risk management systems may not be as attractive.

Thus based on the above discussion, the first hypotheses of this study is as follows:

Hypothesis 1: The probability of ERM implementation is higher for biotech SMKIFs than for SMKIFs in the business services sector (namely accounting and legal firms).

2.3.2 Firm Size

Larger firms tend to be more complex with numerous different organisational activities, and the related risks varied in their nature, timing and extent. Thus compared to smaller firms, larger firms will need a more systematic formal approach for managing risks through a coordinated effort and oversight by senior management. Furthermore it is also likely that larger firms have more resources, both financial and human skills to enable implementation of a more integrated and sophisticated method of risk management. Colquitt

et al. (1999) provide some preliminary support indicating strong association between firm size and the use of integrated risk management systems. Likewise, Beasley et al. (2005) also found entity size to be significantly related to the stage of ERM. Thus, the second hypothesis for this study is as follows:

Hypothesis 2: The probability of ERM implementation is higher for larger-sized SMKIFs compared to smaller-sized SMKIFs.

2.3.3 Top Management Support

Given that an ERM approach encompasses a wide range of organisational functions and units, strong support from those accountable for risk management such as the Board and senior management will be critical for its uptake (Walker, Shenkir and Barton, 2002). Beasley et al. (2005), for instance, find that commitment to ERM by the board of directors and senior managers, such as the chief executive and finance director, as one of the main factors affecting a firm's level of ERM implementation. Corporate governance recommendations, rules, and legislation increasingly place the responsibility for proper governance and risk management on board of directors. This has led boards to take active leadership in setting a framework for enterprise-wide risk management. Thus, the third hypothesis for this study is as follows:

Hypothesis 3: The probability of ERM implementation is positively associated with the strength of directors' drive of risk management.

Organisational-level risk stance

The attitude to risk management is an important factor that affects one's preference for the approach undertaken in managing risks. Collier et al (2007) for instance categorised the risk stance that organisations could take relating to whether risk management is about avoiding negative consequences as opposed to achieving positive consequences. Their

finding, in general, indicates that participants classified as 'hierarchists' i.e. those who agreed that risk management is about avoiding negative consequences and disagreed that its was about achieving positive consequences, perceived that use of both basic and sophisticated technical methods to be highly effective risk management methods. By contrast those who fell in the risk sceptical or entrepreneurial categories, i.e. those who disagreed risk management is about avoiding negative consequences, did not view any of the basic or sophisticated technical methods to be effective risk management methods.

Given that ERM is a sophisticated and holistic approach to risk management, it is likely that firms concerned about avoiding negative consequences and believe that risk management facilitates avoidance of negative outcomes would be more willing to implement ERM. Thus based on the above discussion, the fourth and final hypothesis for study is as follows:

Hypothesis 4: The probability of ERM implementation is positively associated with organisations where risk management is seen as being avoiding negative consequences.

3. RESEARCH METHOD

3.1 Sample

Data collection was undertaken through a questionnaire survey distributed to the chief risk officer or the chief financial officer of SMKIFs firms. The sample population involved firms from two specific industry sectors: bio-tech, and business services, namely accounting and legal services forming the last sector. The database comprised of three major sources: AusBiotech (<http://www.ausbiotech.org>). Industry experts advised this as the best source of information on bio-tech firms in Australia. AusBiotech is Australia's Biotechnology Industry Organisation, which represents over 3,000 members, covering the human health, agricultural,

medical device, bioinformatics, environmental and industrial sectors in biotechnology. 278
Victorian based bio-tech firms were selected randomly from this database.

The list of accounting firms was compiled from two sources: from accountant list. com
(<http://accountantlist.com.au/accountants.aspx?city=Melbourne>) and from Sensis Com
(www.sensis.com.au). Again industry experts recommended these sources.

The databases comprised of 831 records out of which we randomly selected 301 firms.

The list of legal service firms was compiled from the Victorian Legal practices Directory
(<http://members.liv.asn.au/livweb/LegalPractice.aspx>). This directory covers areas such as
legal referral services, legal practices, LIV accredited specialists, mediators, collaborative
professionals, notary public, law associations and legal organizations. For the purpose of this
research we focused on legal practices. The database comprised of 3863 firms.

We randomly selected a sample of 239 law firms to send questionnaires.

Research Instrument

Questionnaire development was guided by a literature review of prior studies, and in particular, the instrument used by Collier et al. (2006) and Beasley et al (2005) were the main sources for the construction of the questionnaire for this study. The research instrument was pre-tested using four participants: a financial controller who had 15 years of experience in risk management, and three academics who had significant industry experience in internal audit and risk management, and minor re-wording of the questionnaire was undertaken. The questionnaire instrument included distinct sections for each of the independent and dependent variables and a section capturing participants' demographic information. The questionnaire was accompanied by a reply paid envelope for their responses, and follow up calls were made approximately two weeks after the questionnaires were sent out.

Participants

The chief financial officer or the chief risk officer was chosen as survey participants for two key reasons. Firstly, they are in a senior position and thus, are expected to have a very good understanding of the quality of the entity's risk management and related control systems. Secondly, they are often actively involved in the oversight of any system reviews and changes, and also liaise frequently with directors and other senior management.

Of the 818 questionnaires sent out to the organisations selected for participation, a total of 112 responses were received (approximately 14% response rate), of which 104 were useable (13% usable responses). Eight of the returned questionnaires were discarded due to incomplete responses. Although response rate is low, it is similar to response rates achieved in recent survey research involving small to medium sized firms (Collier et al., 2007). As shown in Table 1, nearly 97% the respondents have a graduate, postgraduate, or a professional qualification, 69% are above 45 years of age, and 36% have more than 10 years of working experience. Interestingly, at the individual level, more than 65% were willing to take risks or were keen to take risks, and about 56% of respondents spent more than 20% of their time dealing with risks.

INSERT TABLE 1 HERE

INSERT TABLE 2 HERE

In terms of the characteristics of the sample firms, as shown in Table 2, about 39% respondents were from bio-tech sector, and 39% earned less than 1 million dollars in income, and about 58% had 1-25 employees. Interestingly, about half the firms (51%) were reported as willing or keen to take risks, and 38% of the firms refuse or prefer not to take risks.

Variable Measurement

Risks Faced by SMKIFs

The importance of the types of risk faced by SMKIFs was assessed based on a sixteen-item scale. While most of the items were developed from available literature on the knowledge intensive industry, some were adapted from Collier et al. (2007). Each participant was asked to rate the importance of each type of risk to his/her firm's survival using a 7-point Likert-type scale with 1 = not at all to 7 = a great deal, on 16 types of risks. These include 'inability recruit and retain workers', 'inability protect intellectual property rights', 'takeover risks', and 'damage to reputation'.

Risk Attitude of SMKIFs

The risk attitude was assessed using a four-item scale adapted from Collier et al. (2007). Participants were asked to indicate the extent to which they agree or disagree with four statements on the risk attitude of their organisations, using a 7-point Likert-type scale with 1= strongly agree to 7= strongly disagree. The statements include these phrases: 'avoiding negative consequences', 'achieving positive consequences', 'matter of personal judgement'.

Risk Management Approaches and Methods

Risk management approaches and methods used by SMKIFs were assessed based on an eight-item scale. Items were adapted from Collier et al. (2007). Participants were asked to rate the extent of use of different approaches and methods by using a 7-point Likert-type scale with 1= low to 7= high.

Propensity to take risks

Firm's propensity to take risks was assessed on a five-point scale. Each participant was asked to describe his/her firm's propensity to take risks by selecting one of the five descriptors:

‘refuse to take risks’, ‘prefer not to take risks’, ‘neutral’, ‘willing to take risks’, ‘keen to take risks’.

Drivers of Risk Management

Drivers of risk management were assessed based on an eight-item scale adapted from Collier et al. (2007). Each participant was asked to rate the list of 7 factors on the strength of their influence on risk management in his/her firm using a Lickert-type scale with 1=not at all, 7 = a great deal.

ERM adoption

The current stage of ERM adoption was measured based on a 5-point scale adapted from Beasley, Branson and Hancock (2007) ERM survey. Participants were asked to indicate the firm’s current stage of development selecting one of the descriptors. These descriptors range from ‘complete formal enterprise-wide risk management in place’ to ‘no enterprise-wide risk management process in place and no plans to implement one’.

1 = Complete ERM is in place

2= Partial ERM is in place

3 = Planning to implement ERM

4 = Investigating ERM, but no decision made yet

5 = No plans to implement ERM

Those responding to 1 and 2 were classified as 1 representing ERM implementation, and responses in the 3-5 categories were classified as No ERM implementation (0).

Statistical Analysis

A binary logistic model was utilised to test the four research hypotheses. For this study, the binary logistic model was the preferred method of analysis because the dependent variable was conceptualised as a binary construct i.e. ERM implemented or not. The model tested is as follows:

$$\ln \frac{P}{1-P} = B_0 + B_1 \text{ Industry} + B_2 \text{ Firm Size} + B_3 \text{ Director} + B_4 \text{ Risk Stance} + \text{error term}$$

where P is the probability that the firm has implemented ERM,

(1 -P) is the probability that the firm has not implemented ERM

Industry = bio-tech (1) or business services i.e. accounting or legal sector (0)

Firm Size = Revenue less than 0.5 million (1) or revenue larger than 0.5 million (0)

Directors' involvement = The extent of directors driving risk management in the firm (1= Not at all; 7= A great deal)

Risk Stance = Extent of risk management in organization perceived as being to avoid risks (1: Strongly Agree; 7= Strongly Disagree).

The logit model postulates that the binary dependent variable is drawn from logistic cumulative function distributions with selection probabilities conditioned on the observed values of the independent variables. B₁-B₄ test the Hypotheses 1-4 respectively and if significant will indicate that the respective hypothesis as being supported. The goodness of fit associated with the model can be assessed by examining the Hosmer-Lemeshow Goodness-of-fit statistic with a non-significant result indicating that the overall model fit is acceptable.

4.0 FINDINGS

4.1 Nature and Extent of Risk Management Practices in SMKIFs

RQ 1: What are the different types of risk faced by SMKIFs in Victoria, and how are these ranked?

As shown in Table 3 'damage to reputation' and inability to recruit and retain skilled workers are the two highest ranked risks. It is interesting to see bio-tech firms' ranking of damage to reputation as the highest risk for firm survival, preceding other types of risks including technological development risks. Managers of non-biotech firms ranked 'inability to recruit and retain skilled workers' as the most important risk which affects their firms' survival. This

was ranked second by bio-tech firms. These results indicate that ‘inability to recruit and retain skilled workers’ is an important risk to knowledge intensive industry whether they are bio-tech or not. The third ranking risk for both types of firms is ‘increase in costs’. Interestingly, withdrawal of support by providers of capital and uncertainty in industry environment are ranked more highly by biotechs than business service SMKIFs which possibly reflect the greater uncertainty faced by the biotechs. The full list of risks is given in Table 3.

INSERT TABLE 3 HERE

RQ 2: What is the general risk attitude within these SMKIFs i.e. being risk averse or being risk-takers, and is risk management about avoiding negative consequences or achieving positive outcomes?

Overall 75% of the managers agreed that their firm’s attitude toward risk management is ‘avoiding negative consequences’. Only 18% disagreed while 7% was neither agreed nor disagreed. This dimension was again assessed by the answers to the statement ‘risk management in your organisation is about achieving positive consequences’. Overall 57% agreed with this statement, while 33% disagreed and 10% were neutral. These results clearly show that, according to the senior managers, risk is about negative consequences. The results also indicate that 77% of non-bio firms view risk as ‘negative consequences’ while only 73% of bio-tech firms view so. Similarly, while 61% bio-tech firms consider risk as to do with ‘positive consequences’, only 54% of non-bio-tech firms agree with this attitude about risk. (see Table 4). The results clearly indicate there is a significant difference in the attitude toward risk between bio-tech and non-bio-tech firms.

INSERT TABLE 4 HERE

In relation to risk management stance, 42% of the respondents view their firm as being willing to take risks or keen to take risks and interestingly, 48% of respondents believe that their firms either 'refuse to take risks' or 'prefer not to take risks'. However, a comparison between bio and non-bio tech firms indicates bio-tech firms are more willing to take risks than business service firms (i.e., accounting and legal) i.e. 56% of bio-tech firms are willing or keen to take risk, while only 36% for non-bio-tech firms are seen as being willing to do so. It is possible given that bio-tech firms are likely to be operating in a more dynamic and entrepreneurial environment and as such this is reflected in their willingness to take risks compared to accounting and legal firms.

RQ3: What are the common risk management approaches and methods adopted in SMKIFs?

The most common risk management method used by SMKIFs is 'experience, intuition, hindsight, judgement'. The second ranking method is 'brainstorming and scenario analysis'. The sophisticated, quantitative methods such as modelling, statistical analysis, and risk management software ranked at the very bottom. (Please see Table 6). The results indicate that all the most common risk management methods adopted by SMKIFs are qualitative and involve personal judgement.

RQ4: Is there a difference in the risk management approaches and methods between technology-oriented SMKIFs (e.g., bio-tech) and business service-focused SMKIFs (e.g., accounting and legal)?

In both bio-tech and non-bio-tech firms the most commonly used risk management method is 'experience, intuition, hindsight, judgement'. While the second ranking method in bio-tech firms is 'likelihood-consequence matrix, it is 'brainstorming and scenario analysis in non-bio-

tech firms. The sophisticated, quantitative methods such as modelling, statistical analysis, and risk management software ranked at the very bottom in both categories of firms. (Please see Table 5) The results indicate that all the most common risk management methods adopted by KISMES, irrespective of the fact they are bio-tech or non-bio-tech are qualitative and involve personal judgement. There is no significant difference between bio-tech and non-biotech firms in the use of risk management methods.

INSERT TABLE 5 HERE

To what extent ERM is adopted in SMKIFs?

Only 16% percent of SMKIFs reported having complete and formal ERM process in place. However, 38% firms reported having a partial ERM process in place. Thirty-two per cent (32%) of firms do not plan to have an ERM process in the foreseeable future.

Bio-tech firms' full or partial adoption of ERM is 67% which is higher than that of non-bio-tech firms (44%). While only 16% of bio-tech firm have neither an ERM in place or nor plans to have one, this percentage is 44% in non-bio-tech firms. Therefore, acceptance of ERM is much lower in non-bio-tech firms.

INSERT TABLE 6 HERE

4.2 Binary Logistic Regression Results

Table 7 presents the descriptive statistics and correlation matrix of the independent and dependent variables used in the regression analysis, and Table 8 presents the results of the binary logistic regression model. As shown in Panel A of Table 7, fifty-four per cent (54%) of the sample have implemented ERM either fully or partially ($n = 55$), and about 61% of the

firms have revenues less than \$500,000. Panel B, indicates directors are perceived as being drivers of risk management to some extent (mean = 1.72). Panel C of Table 7 provides the Spearman's rho correlations between the four independent variables and the dependent variable. Industry, firm size and directors involvement are significantly correlated with ERM implementation.

Table 8 provides the results of the *ERM Implementation* logistic regression model. The Hosmer-Lemeshow Goodness-of-fit statistic is non-significant ($\chi^2 = 3.052$, d.f. =7, $p=0.88$) suggesting that the overall model fit is acceptable. In addition, the model yielded a Nagelkerke R^2 of 19% indicating that the independent variables make a significant contribution to the variance in the probability of ERM implementation. According to the Wald statistic, B_1 , B_2 and B_3 were found to be significant, and thus bio-tech firms, firm size and directors' support of risk management are significant predictors of the probability of ERM implementation in SMKIFs ($z = 2.429$, $p < 0.10$; $z = 4.339$, $p < 0.05$; $z = 2.770$, $p = 0.10$, respectively). Therefore, Hypothesis 1, 2 and 3 are supported. However, Hypothesis 4 was not supported as B_4 was not significant ($z = 1.381$; $p > 0.10$), respectively, suggesting there risk stance did not make a difference in ERM implementation.

INSERT TABLE 7 HERE

INSERT TABLE 8 HERE

5. Discussion of Results

Overall, the results of this study indicate the existence of a wide set of perceived risks and differences in the risk stance i.e. willingness to take risks between the bio and business services sectors. Risks related to organisational reputation, staff recruitment, client loyalty as well as increasing costs were highly ranked. For bio-tech SMKIFs withdrawal of capital by investors were also seen as a top ranking risk. As such, this suggests that ERM systems in

SMKIFs in the bio industry ought to pay more attention to the firm's financing options or sources while ensuring an organisation wide attention to reputational and cost management issues.

The method of risk management that is commonly used in SMKIFs is personal judgement, with quantitative and sophisticated methods rarely used. This result corroborates with the results of Collier et al. (2007) who found managers from SMEs tend to use heuristic approaches rather than more technical oriented approaches to risk management.

SMKIFs still seem to overwhelmingly adopt qualitative and conventional piecemeal approaches to managing risks. They also seem to perceive risks from the standpoint of its impact on negative consequences i.e. focus more on down-side risks. **Whether more simplistic approaches to risk management is effective for SMKIFs is ground for future studies.**

The binary logistic regression model on ERM implementation provides significant support to the influence of SMKIF sector (i.e. bio-tech or not), entity size and involvement of board of directors in risk management on whether SMKIFs implement ERM or not. This finding largely concurs with the results of Colquitt et al (1999) and Beasley et al (2005). Given the substantial emphasis and focus on boards of directors and their role in governance leadership, the positive association between directors' support and involvement in risk management and the implementation of ERM is encouraging.

Furthermore, it would appear bio-techs are more likely to implement ERM. The more dynamic and volatile business environment faced by bio-techs is likely to justify their investment in more organisation wide approaches to risk management. Albeit, the present study focused on a fairly narrow range of non-sectors within SMKIFs i.e. only two types of business service firms, and future studies may examine other business service sectors e.g. management consulting. Unfortunately, our study does not support the relationship between risk stance and the probability of ERM implementation.

In summary, more effective risk management should enable knowledge intensive firms to create and exploit knowledge as a source of competitive advantage and adapt to new environments more successfully (Kuivalainen et al, 2004). Our results indicate larger firms that have strong support from the board of directors are more likely to implement ERM systems. Future studies may take a closer examination of whether and how the effectiveness of an ERM relates to the nature or type of risk. For example, can ERM more easily deal with financial risks rather than intangible business risks such as reputation risk?

6. Conclusion and Suggestions for Future Research

This study fills an important gap in the literature by addressing the nature and extent of risk management practices in an important industry i.e. the knowledge intensive industry. While the research has been largely exploratory in nature, it provides some important insights into the risk management practices within SMKIFs. In doing so, the study potentially contributes to improving governance of risks, and ultimately the performance of SMKIFs, leading to higher wealth creation capacity at the national and regional levels (OECD, 2004). However, the results of this study need to be interpreted with caution given the following limitations of the study.

Firstly, the survey relates to only a small sample size of the population. The response rate (13%) is also a limitation. While random follow-up calls were made to encourage questionnaire return, many firms seem to have either moved or not exist any more. Probably, this may reflect an expected characteristic of SMKIFs that is high mortality. Furthermore, our sample covers only Victorian SMKIFs due to funding limitations. This presents an opportunity for future research to extend the current study nation-wide. In addition, the sample involves firms from only two types of sectors in the knowledge intensive industry – bio-tech and business services. Future studies may consider investigating R&D and other

types of knowledge intensive firms as well. An additional limitation of this study is that the term ERM is still new and a common understanding and conceptualisation of ERM may still be lacking. As such, reliability of ERM implementation measure may be lower, e.g. firms that have responded to having implemented ERM may only construe it from a narrow perspective. However, the respondents were given a well-accepted definition of ERM i.e. as per the COSO model, and thus this may have helped for a common interpretation of the term. Finally, the usual caveats of survey research also apply.

In conclusion, we believe that this study provides a starting foundation for research into knowledge intensive firms in Australia. Given Australia's aspirations to be a leading knowledge nation, further research into the governance and risk management of firms in the knowledge industry is vital for developing better public policy.

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Table 1 Characteristics of managers

Qualification	Graduate	Post Graduate	Professional	Other	
Total					
Number of managers	20	36	39	3	
Percentage	20.4%	36.7%	39.8%	3.1%	
<hr/>					
Age (years)	25-34	35-44	45-54	>55	
Number of managers	10	25	32	37	
Percentage	9.6%	24%	30.8%	35.6%	
<hr/>					
Experience (years)	<2	3-5	5-10	10-15	>15
Number of managers	14	28	25	8	29
Percentage	13.5%	26.9%	24%	7.7%	27.9%
<hr/>					
Risk taking propensity	Refuse to take risks	Prefer not take risks	Neutral	Willing to take risks	Keen to take risks
Number of managers	1	21	14	62	4
Percentage	1%	20.6%	13.7%	60.8%	3.9%
<hr/>					
Percentage of time dealing with risk	1-19%	20-39%	40-59%	60-79%	80-100%
Number of managers	44	30	13	11	5
Percentage	42.3%	28.8%	12.5%	10.6%	4.8%
<hr/>					
Level of involvement with risk	Insufficient	About right	Too involved	No view	
Number of managers	15	77	3	2	
Percentage	15.5%	79.4%	3.1%	2.1%	

Table 2 Characteristics of firms

Business	Accounting	Legal	Bio-Tech		
Number of firms	38	25	41		
Percentage	36.5%	24%	39.4%		
Type of firm	Parent company	Subsidiary / branch	Joint vent. / alliance	Individual firm	
Total					
Number of firms	17	3	3	81	
Percentage	16.3%	2.9%	2.9%	77.9%	
Biotech					
Number of firms	13	3	3	25	
Percentage	29.5%	6.8%	6.8%	56.8%	
Non Biotech					
Number of firms	4	0	0	56	
Percentage	6.7%	-	-	93.7%	
Ownership	ASX listed company	Unlisted company	Partnership	Sole Proprietor	Other
Total					
Number of firms	12	41	17	18	14
Percentage	11.8%	40.2%	16.7%	17.6%	13.7%
Biotech					
Number of firms	11	14	3	2	13
Percentage	25.6%	32.6%	7%	4.7%	30.2%
Non Biotech					
Number of firms	1	27	14	16	1
Percentage	1.7%	45.8%	23.7%	27.1%	1.7%
Revenue (A\$)	<0.5 Mil	0.5-1 Mil	1-10 Mil	10-50 Mil	>50 Mil
Total					
Number of firms	23	17	41	13	8
Percentage	22.5%	16.7%	40.2%	12.7%	7.8%
Biotech					
Number of firms	6	5	17	8	7
Percentage	14%	11.6%	39.5%	18.6%	16.3%
Non Biotech					
Number of firms	17	12	24	5	1
Percentage	28.8%	20.3%	20.7%	8.5%	1.7%

Employees	1-5	6-25	26-100	101-250	>250
Total					
Number of firms	31	29	27	7	9
Percentage	30.1%	28.2%	26.2%	6.8%	8.7%
Biotech					
Number of firms	8	10	14	3	8
Percentage	18.6%	23.3%	32.6%	7%	18.6%
Non Biotech					
Number of firms	23	19	13	4	1
Percentage	38.3%	31.7%	21.7%	6.7%	1.7%
Risk taking propensity					
	Refuse to take risks	Prefer not take risks	Neutral	Willing to take risks	Keen to take risks
Total					
Number of firms	6	33	12	51	2
Percentage	5.8%	31.7%	11.5%	49%	1.9%
Biotech					
Number of firms	0	15	4	23	2
Percentage	-	34.1%	9.1	52.3%	4.5%
Non Biotech					
Number of firms	6	18	8	28	0
Percentage	10%	30%	13.3%	46.7%	-

Table 3 Risk rankings

Type of Risk	Overall (Rankings)	Biotech Firms (Rankings)	Non Bio Firms (Rankings)
Damage to reputation	1	1	2
Inability to recruit and retain skilled workers	2	2	1
Increase in costs	3	3	3
Competition from other firms	4	6	5
Reduction in prices/fees	5	9	4
Clients changing minds/renegeing on commitments	6	7	6
Uncertainty in industry/sector environment	7	5	7
Inability to protect intellectual property rights	8	8	8
Unexpected delays in product/service development	9	11	10
Not having diversified products services	10	10	12
Withdrawal of support by providers of capital	11	4	15
Opportunistic behaviour of partner/alliance firms	12	13	11
Technological development making yours obsolete	13	14	9
Products/services not approved by authorities	14	12	14
Lack of resources (land, building, equipment)	15	15	13
Takeover risks	16	16	16

1=Most significant type of risk, 16=Least significant type of risk

Table 4 Attitude towards risk management

Risk Management is	Overall (%)			Biotech Firms (%)			Non Bio Firms (%)		
	A	N	D	A	N	D	A	N	D
About avoiding negative consequences	75	7	18	73	9	18	77	5	18
About achieving positive consequences	57	10	33	61	11	28	54	9	37
More a matter of personal judgment	35	22	43	25	25	50	42	20	38
Handled through a formal system that identifies, manages and reports risk	64	10	26	71	4	25	59	14	27

A=Agree, N=Neutral, D=Disagree

Table 5 Methods used for risk management and their effectiveness

Method	Rank based on extent of use	Manager's %
Experience, intuition, insight, judgement	1	78%
Brainstorming, Scenario Analysis	2	48%
Risk registers and written reports	3	37%
Auditors or external consultants	4	36%
Likelihood/ consequences matrix	5	30%

Manager's % = percentage of managers agreeing that this method is useful in risk management.

Table 6 Current stage of ERM development

	Overall		Biotech Firms		Non Bio Firms	
	No.	%	No.	%	No.	%
Complete formal ERM process in place	16	15.7	12	27.9	4	6.8
Partial ERM process in place	39	38.2	17	39.5	24	37.3
No ERM process, but planning to have one	9	8.8	5	11.6	4	6.8
Investigating the ERM concept, no decision yet	5	4.9	2	4.7	3	5.1
No ERM process in place, no plans to have one	33	32.4	7	16.3	26	44.1

Table 7
Descriptive Statistics and Correlation Matrix

Panel A: Binary Variables				
<i>ERM Implementation</i>	Yes = 55	53.9%	No = 47	46.1%
<i>Industry</i>	Bio Tech = 66	63.5%	Others = 38	36.5%
<i>Firm Size</i>	< \$ 0.5 mil = 23	22.5%	> \$ 0.5 mil = 79	77.5%
Panel B: Continuous Variables				
	Mean	Standard deviation	Minimum Actual (Theoretical)	Maximum Actual (Theoretical)
<i>Directors' Involvement</i>	1.72	2.57	1 (1)	7 (7)
<i>Risk Stance</i>	1.22	1.69	1 (1)	7 (7)
Panel C: Correlation Matrix				
	<i>Industry</i>	<i>Firm Size</i>	<i>Directors' Involvement</i>	<i>Risk Stance</i>
<i>Industry</i>	1.000			
<i>Firm Size</i>	-0.170	1.000		
<i>Directors' Involvement</i>	0.166**	-0.108	1.000	
<i>Risk Stance</i>	0.064	-0.076	0.053	1.000
<i>ERM Implementation</i>	0.203*	0.266**	0.223*	0.157

* p < 0.05; ** p < 0.01 (2-tailed significance test)

Table 8
Binary logistic regression analysis of ERM Implementation

Dependent Variable: ERM Implementation (n = 102)				
	Predicted Sign	β	Standard error	Wald statistic (z-ratio)
<i>Industry</i>	+	0.710	0.456	2.429 *
<i>Firm Size</i>	+	0.948	0.455	4.339**
<i>Directors' Involvement</i>	+	0.154	0.092	2.770**
<i>Risk Stance</i>	-	0.164	0.140	1.381
Constant		-0.333	0.453	0.542
Model summary	-2 LogLikelihoodRatio = 118.730			
Model χ^2	$\chi^2 = 14.904$, d.f. = 4, $p = 0.005$			
Nagelkerke R^2	$R^2 = 0.190$			

* $p < 0.10$; ** $p < 0.05$ (one-tailed test of significance)