Operational risk management (ORM) systems – An Australian study

By

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I certify that the work in this thesis has not previously been submitted for a degree, nor has it been submitted as part of requirements for a degree except as fully acknowledged within the text.

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Signature of Student

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Abstract

In today's business environment, increased competition, market globalisation, increased customer demands and accelerated technologies require organisations to focus on efficiency in every aspect of their operations. Many studies in operations management have focused on the improvement of operational performance, including reduction of process variability, increasing flexibility or implementing controls in operations. However, managing the risk in operations seems to have been neglected by researchers.

Hence, there are two major objectives of this study. The first objective is to investigate the use of the operational risk management (ORM) systems in Australia and study the factors that have an impact on effective operational risk management. Then, based on the identified factors, the second objective is to develop an ORM system implementation model and guideline for Australian organisations.

A review of the ORM systems and its implementation was conducted. As a result of this investigation, a definition of ORM system in this study was formulated and the factors of effective ORM system implementation were identified as a basis for the next stage of this study.

An investigation of the factors of ORM system implementation was then carried out. An extensive questionnaire survey was used to collect empirical data from Australian organisations. Statistical analysis results and feedback from experts was used to develop an applicable model and guideline for ORM system implementation.

The main outcome of this study is a proposed model and guideline for ORM system implementation in Australian organisations, which will assist the organisation to manage operational risks more effectively and provide motivation for carrying out further research in ORM.

Chapter 1 Introduction

1.1 Background to the research

1.1.1 Operational risk (OR)

Today's business environment is more complex than ever. All businesses have to live with uncertainties in every aspect of their operations. According to Raz and Hillson (2005), there is an increasing interest in improving the organisational ability to deal with those uncertainties.

Organisations can be considered as systems consisting of many components (e.g. people, products, processes, culture, etc.) that interact with each other and create synergies (Akpolat 2004). Regardless of its purpose (e.g. to make profit or not), every organisation employs a set of core functions and activities to achieve its goals and objectives. These functions and activities have the potential to generate negative consequences or risks for its employees (Brown 1996; Brown et al. 2000), for customers (McFadden & Hosmane 2001), for the environment (Angell 1999; Geffen & Rothenberg 2000) and for various other stakeholders (Peters 1999). Therefore, managing risks in operations is essential for any organisation in order to enhance their operational performance and management efficiency to satisfy their employees, local community, shareholders, customers and other stakeholders.

Operational risk typically covers a broad range of risks that are internal to an organisation (Corrigan 1998). It can be defined as the risks associated with losses that may result from inefficiencies or non-conformances within the operational processes of an organisation including quality, environmental, and occupational health and safety risks (Cooke 2004; Raz & Hillson 2005). According to Frame (2003), operational risk is different from other types of risks as it deals with established processes rather than managing unknown circumstances. However, Williams et al (2006) points out that managing operational risk is not an easy undertaking because operational risks are interrelated in many complex ways. One operational risk can have impacts on other operational risks in the system.

1.1.2 Managing operational risk

In the past, most organisations managed their operational losses by relying on insurance underwriting and some protective equipment, such as fire extinguishers, to limit their losses (Sadgrove 1996). Nowadays several factors including government, customer and public concerns have made insurance and passive actions inadequate. These contextual changes have led to operational risk management (ORM) becoming an essential element for most organisations (Waring 2001). However, the number of empirical researches in ORM is limited.

In financial and insurance fields, on the one hand, most research studies have focused more on the management of market risk, credit risk and other financial risks rather than operational risk (Cooke 2004; Frost et al. 2001; Hanna et al. 2003). According to Cruz (2002), there has been an increasing trend of interest in ORM in financial and insurance fields after the Barings Bank collapse in 1995.

In the operations management field, on the other hand, managing operational risks has been also largely neglected in the past (McFadden & Hosmane 2001). Many researchers dedicated their efforts more on improving operational efficiencies, which include reducing process variability, increasing flexibility or implementing controls rather than systematically managing risks in operations (Cooke 2004).

1.1.3 Operational risk management (ORM) systems

Although the concept of ORM is still at an immature stage, the need for effective ORM has increased substantially. It has led to an increasing number of books, articles and conferences in ORM as well as the development of a number of standards and guidelines that advise organisations on the 'best practice' of ORM (Raz & Hillison 2005). Table 1.1 shows some of the most widely used national and international standards as well as professional standards and guidelines for ORM. Clearly, most of the standards and guidelines were recently published. Some standards and guidelines have been developed to address ORM in the broadest sense dealing with all types of risks in operations while others have more explicit guidelines to manage specific risks only.

Table 1.1 ORM standards and guidelines

Reference/title	Author	Date	ORM coverage
National and international standards			
AS/NZS 4360:2004, Risk Management	Standards Australia and Standards New Zealand	2004	All
HB436:2004, Risk Management Guideline Companion to AS/NZS 4360:2004	Standards Australia and Standards New Zealand	2004	All
AS/NZS 4801:2001, Occupational Health and Safety Management Systems - Specification with Guidance for Use	Standards Australia and Standards New Zealand	2001	Safety risks
CAN/CSA-Q850-97, Risk Management: Guideline for Decision Makers	Canada Standards Association	1997	All
ISO 9001:2000, Quality Management Systems - Requirements	International Organization for Standardization	2000	Quality risks
ISO 14001:2004, Environmental Management Systems - Requirements with Guidance for Use	International Organization for Standardization	2004	Environmental risks
ISO/IEC 17799:2005, Information Technology - Security Techniques - Code of Practice for Information Security Management	International Organization for Standardization and International Electrotechnical Commission	2005	IT risks
JIS Q 2001:2001 (E), Guidelines for Development and Implementation of Risk Management system	Japanese Standards Association	2001	All
Professional standards/guidelines			
A Risk Management Standard	Institute of Risk Management (IRM), Association of Insurance and Risk Managers (AIRMIC) and National Forum for Risk Management in Public Sector (ALARM), UK	2002	All
Enterprise Risk Management - Integrated Framework	The Committee of Sponsoring Organizations of the Treadway Commission (COSO), USA	2004	All
New Basel Capital Accord - Consultative Document	Basel Committee on Banking Supervision, Switzerland	2001	All

Source: Adapted from Raz and Hillson (2005); Hillson (2006)

Paralleling the growth of ORM recognition is a significant increase in how to implement those standards and guidelines for an effective ORM system. According to Hillson (2006), having more than one standard is the lack of standardisation, which would result in confusion and unsuccessful implementation of an ORM system.

1.1.4 Status of ORM system implementation in Australia

Over the past decades, the use of standards and guidelines to proactively manage risks in operations has been common in Australia and other developed countries. However, implementation of standards and guidelines differs between organisations.

In Australia, various standards and guidelines are presently being used to manage risks in operations. One of these standards is based on the risk management system standard AS/NZS 4360. Australia and New Zealand have pioneered the development of risk management system standards (see AS/NZS 4360 series). Many organisations in Australia use the AS/NZS 4360 standards as a basis for their ORM system from a generic as well as a specific perspective (McCarty & Power 2000; Knight 2002). However, organisations seem to have difficulties in its implementation. A survey conducted by Standards Australia in conjunction with Bergman Voysey & Associates has revealed that only 18% of the surveyed organisations have satisfactorily implemented the AS/NZS 4360 (Jabbour 1999). In addition, there is a limited number of empirical research studies about the applicability or usage of this standard, or its effectiveness in handling operational risks.

The enterprise risk management (ERM) framework is an alternative option preferred by some organisations (Berry & Phillips 1998; Merkley 2001; Eiss 1999; Kayfish 2001; Barrett 2003; Walker et al. 2003; Funston 2003; Schneier & Miccolis 1998). In Australia, the most commonly published and referred to ERM framework is the Committee of Sponsored Organisations (COSO) ERM framework. According to COSO (2004), this ERM framework has many benefits to organisations. However, there seems to be limited empirical research evidence to back it up. A recent survey conducted by the IIA Research Foundation about the COSO ERM framework in various regions including USA, Canada, Europe and Australia has revealed that most companies were aware of the COSO ERM framework; however, only 11% of responding organisations fully implemented it (Beasley et al. 2005). Furthermore, a survey conducted by the Australian National Audit Office (ANAO) showed that most organisations were facing difficulties with ERM implementations. Some of the common problems mentioned in the survey included the organisational culture and lack of expertise in implementation of the ERM framework (McPhee 2003).

As another alternative, many organisations favour managing operational risks using operations management system standards. As Akpolat and Xu (2002) point out, the implementation of these standards can be considered as a proactive approach to manage operational risks. The most commonly used operations management system standards in Australian organisations dealing with operational risk include the following:

- **AS/NZS/ISO 9001:2000** - Quality Management Systems. This standard provides a generic quality management framework and continuous improvement model to prevent poor quality products and services.

- **ISO 14001:2004** - Environmental Management Systems. This standard provides a guideline to identify potential risks (environmental aspects) of harming the environment (environmental inputs). This helps in complying with environmental legislation and managing environmental risk.

- **AS/NZS 4801:2001** - Occupational Health and Safety Management Systems. This standard provides guidelines to identify hazards, and control and monitor risks. It also helps in complying with occupational health and safety legislation, and managing risks related to occupational health and safety.

- **ISO/IEC 17799:2005** - Information Security Management Systems. This standard specifies a guideline for securing a documented Information Security Management System to manage information security risk.

Quality management system is one of the most frequently studied frameworks in operations management research (Williams et al. 2006). Consistent with this fact, many organisations seem to prefer the quality management system as a foundation for implementation of the other management systems (Pitinanondha & Akpolat 2005). In the past few years, many organisations in Australia and elsewhere implemented environmental, occupational health and safety, and information security management systems in addition to their existing quality management system.

Over the past decade, although the organisations in Australia have used one or more standards to manage risks in their operations, two surveys conducted by KPMG's Sydney office in 1996 (Tilley 1996) and spot poll conducted by Deloitte in May 2007 (Nicholls 2007) showed similar results that nearly 60% of the Australian organisations still lack of effective risk management and training. Moreover, there is an increasing trend in prosecution for breaching the laws such as the *Environmental Protection Act 1994* and *Trade Practices Act 1974* in Australia as shown in Table 1.2 and Table 1.3. These results reflect that there is a need for effective ORM processes to help organisations to sustain overall organisational performance.

Table 1.2 Environmental prosecution cases

State	1998-1999	1999-2000	2000-2001	2001-2002	2002-2003
New South Wales	85	115	94	109	115
Victoria	25	44	46	29	34
South Australia	1	1	5	5	2
Tasmania	N/A	N/A	0	2	1

Source: Annual Reports, Environment Protection Authorities (EPA)

Table 1.3 Breaching Trade Practices Act cases

	1999-2000	2000-2001	2001-2002	2002-2003
No. of Cases	77	85	110	198

Source: Annual Reports, ACCC

1.2 Research objectives

The main purpose of this research was to investigate the use of ORM systems in Australia and study the factors that have an impact on implementation of ORM systems. These factors are then used to develop a model and guidelines for an effective ORM system implementation.

In this research, new knowledge related to managing operational risks in Australian organisations can be derived. This new knowledge is generated from existing operations management knowledge integrated with specific characteristics of risk management in Australia. After reviewing the existing operations management literature, it has become very clear that this research is perhaps the only one that systematically examines the use of ORM systems to manage operational risks in Australian organisations.

1.3 Research questions

Based on the research objectives, the extensive literature review, brainstorming sessions with the author's supervisor, and informal talks with risk management practitioners, the following research questions have been formulated:

Question 1: What is ORM system?

Question 2: What are the current ORM system practices in Australian organisations?

Question 3: What are the critical success factors of an effective ORM system implementation?

1.4 Research approach

To achieve the research objectives and answer the research questions, a comprehensive study based on theoretical verification and empirical testing were conducted. The details of approach used in this research are discussed in the subsequent chapters of this report. The summary of each chapter is presented as follows:

Chapter 2 reviews the concept of ORM. It gives a brief history of ORM systems and explains the fundamental concept of ORM system in this research. Thus, the research question 'What is ORM system?' is answered. The current use of ORM systems in Australia is reviewed: generic risk management systems (AS/NZS 4360 Risk management system), enterprise-wide risk management systems (COSO ERM framework) and operations management systems (ISO 9001 quality management system, ISO 14000 environmental management system, and AS/NZS 4801 occupational health and safety management system).

Chapter 3 defines the concept of ORM system in this research based on the findings of the literature review. The ORM system elements (factors) are then discussed and a research model is proposed.

Chapter 4 describes the methodologies employed in this research. The strategies and research design are discussed in greater detail. The development of the research instrument, and method of testing reliability and validity of the instrument are also described in this chapter.

Chapter 5 discusses the results of the survey and the evaluation of the measurement instrument. The status of ORM in Australia and the perception regarding the critical success factors of ORM system implementation in Australian organisations are the two major aspects discussed in this chapter. Thus, the research questions ‘What are the current ORM system practices in Australia organisations?’ and ‘What are the critical success factors of an effective ORM system implementation?’ are addressed. The discussion with academics and industry experts helped the author in interpretation of the survey findings.

Chapter 6 presents a brief summary and the main conclusions of the research. The limitations and suggestions for further study are also addressed.

Chapter 2 Literature review

2.1 Introduction

Through a literature review, this chapter aims to identify the types of ORM systems and their use by Australian organisations. Section 2.2 presents the history and concept of ORM systems. Section 2.3 discusses the ORM systems used in Australian organisations based on a number of researchers in the field of operations management. Finally, Section 2.4 summarises this chapter.

2.2 History of ORM systems

As seen in Figure 2.1, managing risks in operations can be traced back to the beginning of the twentieth century when the scientific management of Frederick Taylor was formally emerged to manage uncertainties and losses in production (Taylor 1911). Scientific management was the first attempt to systematically manage and improve processes. This concept replaced the decision-making based on tradition and rules of thumb which can be seen as a proactive approach to manage risks in operations using scientific methods.

Little (1992) points out that process control, continuous process improvement, and standardisation concepts of scientific management were the important foundations for quality innovation. Around the 1930s, quality control was introduced by Walter Shewhart, who combined statistics with Lewis's Theory of Knowledge to control the variation of production processes and improve product quality (Shewhart 1939). Shortly after the end of World War II, Edward Deming taught Japanese engineers Shewhart's Theory of Variation, statistical process control techniques and "Plan-Do-Control-Act" cycle. The Japanese successfully blended these ideas with their culture and tradition to create a new quality concept called Total Quality Control (TQC). During the 1960s and 1970s, TQC methodology proved to be an effective way of improving production efficiency and product quality. In the 1980s, Western industries began adopting Deming philosophy and Japanese quality concepts under the Total Quality Management (TQM) movement (Deming 1986).

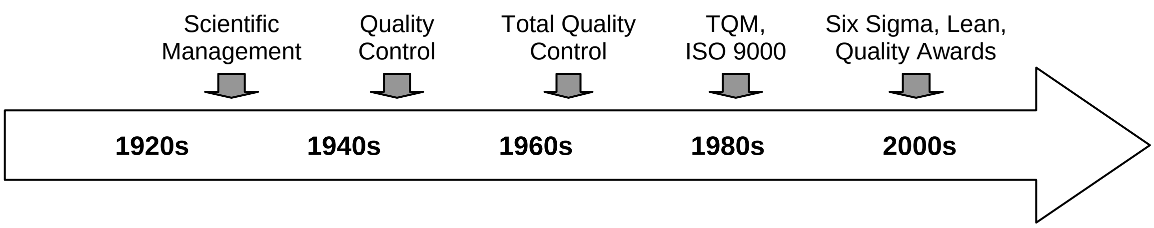

Figure 2.1 History of operational improvements (Adapted from Akpolat 2004)

The idea of quality management and improvement was later adapted into other operational aspects including environment, occupational health and safety, and information security. As part of this movement, several national and international management standards were also developed to help organisations manage losses or risks in those operations (Brumale & McDowall 1999). In the 1990s, many national and international quality awards schemes along with the Six-Sigma framework were introduced to further improve processes and achieve substantial bottom-line results (Akpolat 2004). The modern era of risk management also began in the 1990s, and seemed to incorporate many concepts and ideas of the quality movement.

Sadgrove (2005) argues that risk management can be generally broken down into three ages as shown in Figure 2.2. The first age was around the 1960s and 1970s. Organisations focused only on managing non-entrepreneurial risks. They commonly used an ad hoc or passive approach to manage their risks. However, several changes including stricter government policies, increased customer demands, and growing public concern, have made an ad hoc or passive approach inadequate for dealing with risks. During the second age in the 1970s and 1980s, the organisations adopted various quality concepts to reduce variation in the process as a proactive approach for managing losses. In the current and third age of ORM that began around the mid-1990s, organisations have been focusing on both internal and external risks, and employing management system standards and frameworks as guidelines to systematically control risks.

Risk management is quite comprehensive and has been studied in a broad range of academic perspectives including financial (Bodnar et al. 1998), economic (Marshall 2000), and political (Kobrin 1979; Keillor et al. 2005) aspects. This research is concerned with managing the risks associated with losses within operational processes of the organisation.

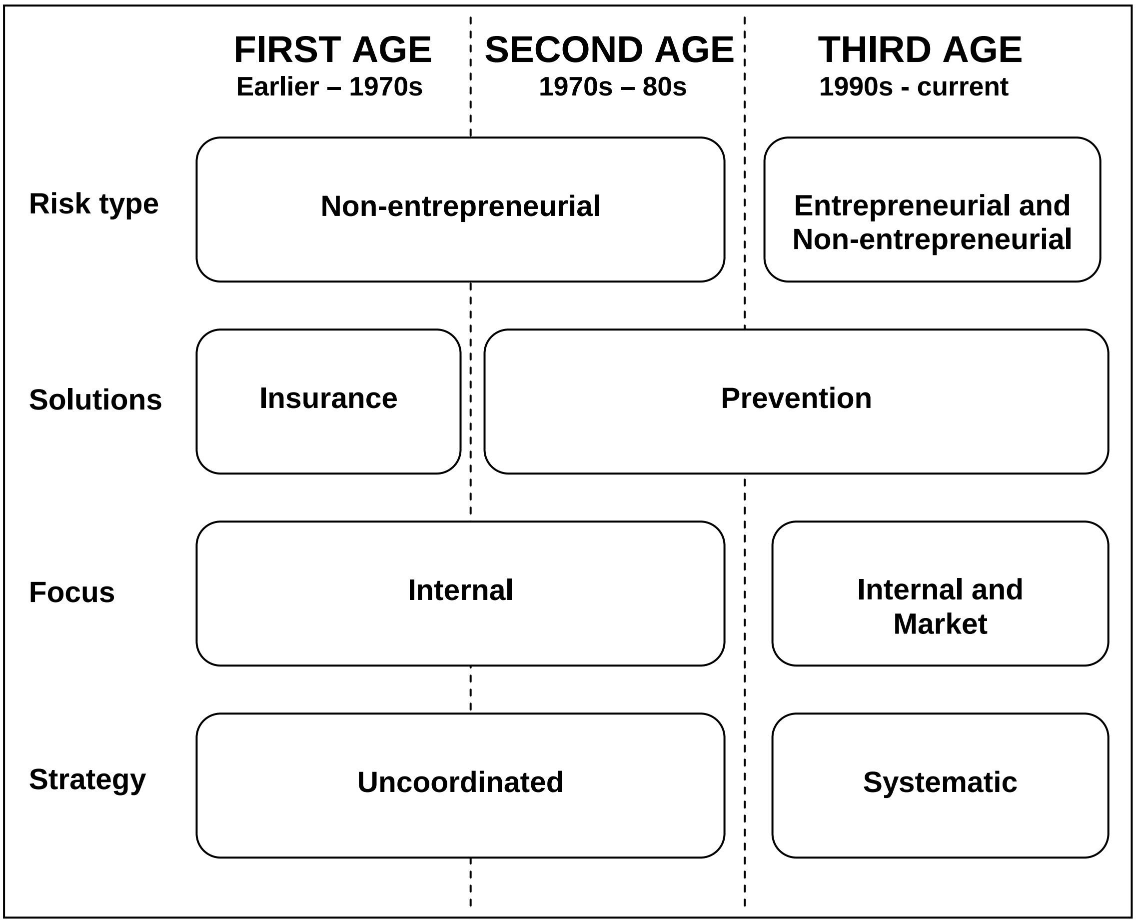

Figure 2.2 The three ages of risk management (Adapted from Sadgrove, 2005)

2.3 The use of ORM systems in Australia

Currently, Australian organisations use many different approaches and methods for managing risks in their operations. These methods can be grouped into three main categories, namely:

- Generic risk management systems
- Enterprise-wide risk management systems
- ORM systems based on operations management systems

In the following sections, each category will be discussed further. This includes first an introduction to the approach, then the detailed analysis of frameworks and models utilised under that approach, and finally the application of those frameworks and models.

2.3.1 Generic risk management systems

2.3.1.1 Introduction

The Australian and New Zealand Standard AS/NZS 4360, published in 1995, is one of the first risk management standards of its kind. Knight (2002) points out that this standard quickly became one of the top-selling standards after its publication. The standard was revised and re-published in 1999. The second revision was published with minor changes in August 2004.

The main objective of AS/NZS 4360 is to assist organisations in the implementation of risk management practices. It provides a risk terminology/glossary, generic implementation guidelines and a framework or model for risk assessment and management. According to Keey (2003), AS/NZS 4360 introduces a simple risk management approach that can be used across various disciplines and industries. Unlike other management systems, there is currently no national or international certification scheme available for a risk management system. It is also important to note that AS/NZS 4360 does not require compliance with any legislative requirements.

2.3.1.2 Generic risk management system frameworks

The AS/NZS 4360 risk management framework can be divided into a risk management program and a risk management process. The risk management program is the practice of risk management within an organisation. It consists of six implementation steps, namely:

- Develop a risk management plan
- Ensure the support of senior management
- Develop and communicate the risk management policy
- Establish accountability and authority

- Customise the risk management process
- Ensure adequate resources.

The AS/NZS 4360 risk management process, as shown in Figure 2.2, consists of the following components:

- Establish the context: Defining a risk management strategy and its objectives, identifying an organisation's capabilities, defining risk evaluation criteria and developing a risk management plan.
- Identify risks: Identifying those (negative) outcomes which may have an impact on an organisation's objectives.
- Analyse risks: Identifying existing controls by considering the range of potential consequences and the likelihood of their occurrence.
- Evaluate risks: Comparing risks against the organisation's established criteria and considering the balance between benefits and outcomes.
- Treat risks: Developing and implementing plans for treating those risks previously established.
- Monitor and review: Monitoring and reviewing the performance and cost effectiveness at each stage of the risk management process for continuous improvement.
- Communicate and consult: Maintaining dialog with internal and external stakeholders at each stage of the risk management process.

In summary, it can be argued that the AS/NZS 4360 model is developed on the basis of the well-known ‘Plan-Do-Control-Act’ (PDCA) methodology. The components ‘Establish the context’ and ‘Communicate and consult’ can be seen as being the ‘Act’ phase, the component ‘Risk assessment’ as the ‘Plan’ phase, the component ‘Treat risks’ as the ‘Do’ phase and the component ‘Monitor and review’ as the ‘Control’ phase. This simple risk management model also provides the answers to the fundamental questions: Why manage risks, how to manage risks, and what risks need to be managed.

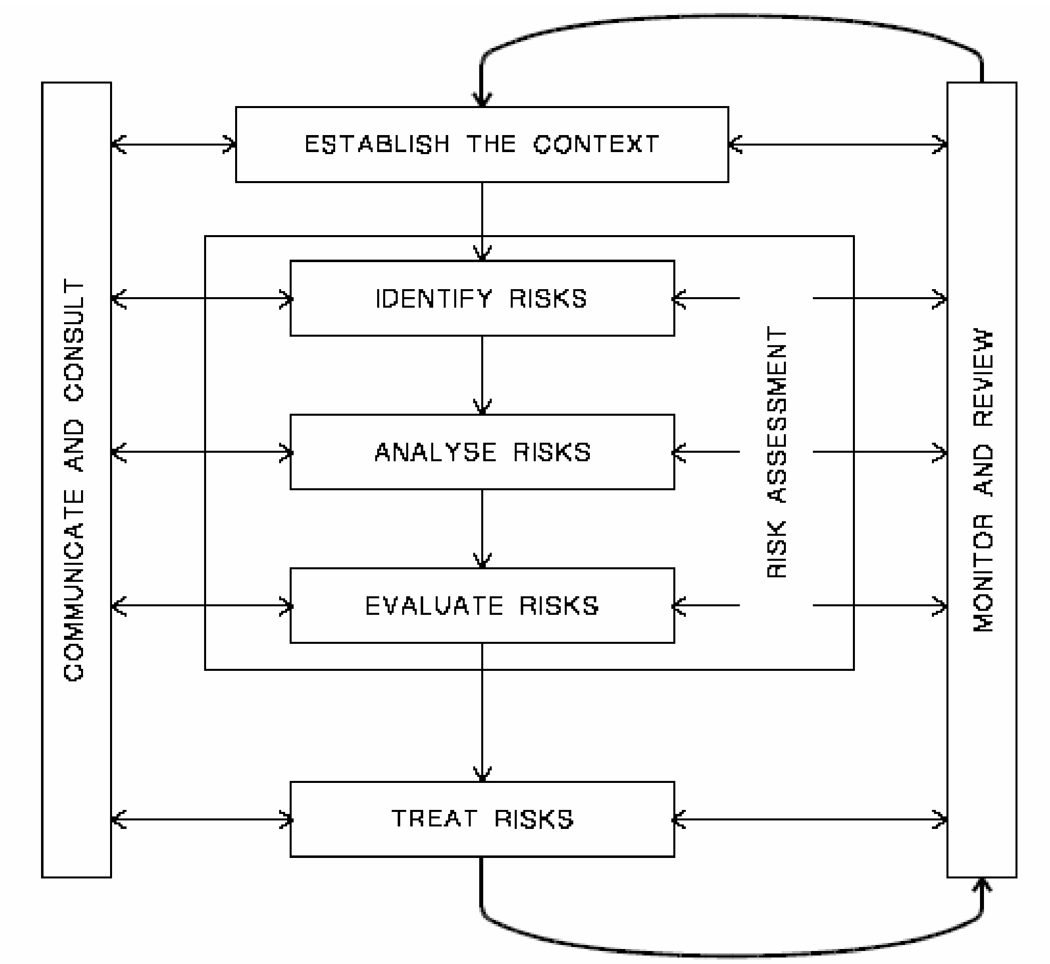

Figure 2.3 The AS/NZS 4360:2004 – Risk management system model

2.3.1.3 Generic risk management system applications

The AS/NZS 4360 provides a framework that can be adapted by any organisation or industry, as it does not emphasise any particular type of risks. As a management framework, it could be applied to a wide variety of activities, decisions or operations ranging from individual projects through to the corporate governance of any organisation. In Australia, the approach outlined in the AS/NZS 4360 has been adopted by federal, state and local government departments (Commonwealth of Australia 1996a, Commonwealth of Australia 1996b) as well as by larger organisations including the Australian Stock Exchange, ANZ Banking Group, Australia Post, Qantas Airways, Telstra, BHP Billiton and Pioneer Australia for their risk management program (Standards Australia and Standard New Zealand 2000).

It is too early to say whether these standards are effective in handling operational risks. The number of research studies on the effectiveness of these standards is limited. However, the case studies conducted by Arthur Andersen and several participating organisations proved that this systematic risk management method enabled organisations to minimise losses and maximise opportunities (Standards Australia and Standard New Zealand 2000).

Despite these positive results, the AS/NZS 4360 has not been used widely as a risk management model. According to a survey conducted among Australian organisations by the consulting and accounting firm KMPG, only 40% of the respondents had formal risk management strategies and policies in place (Tilley 1996). This seems to be due to mainly the lack of management commitment to implementation of a risk management program (Tilley 1997). Moreover, many organisations also appear to have insufficient skills in implementing the framework (Karapetrovic 2003).

2.3.2 Enterprise-wide risk management systems

2.3.2.1 Introduction

ERM is an emerging concept that can be defined as an approach to managing risks in an organisation by integrating and coordinating all risks across the entire organisation (Kleffner et al. 2003; Sharman 2002). In this research, the ERM framework is differentiated as a separate entity to other models which can be used as an enterprise-wide risk management program. Some organisations, for instance, use the AS/NZS 4360 model in conjunction with other management approaches to manage risks across the entire company (Affisco et al. 1997). Other organisations, on the other hand, use their own self-developed models as an enterprise risk management program (COSO 2004; Sharman 2002).

Almost parallel to the AS/NZS 4360, the Committee of Sponsoring Organizations of the Treadway Commission (COSO) developed the risk control methodology 'Internal Control - Integrated Framework'. Recent increases in concerns about risk management practices led COSO then to expand on the Internal Control framework and develop a robust framework called 'Enterprise Risk Management - Integrated Framework'. This framework is currently one of the most commonly published and referred to risk management programs in Australia.

2.3.2.2 ERM system frameworks

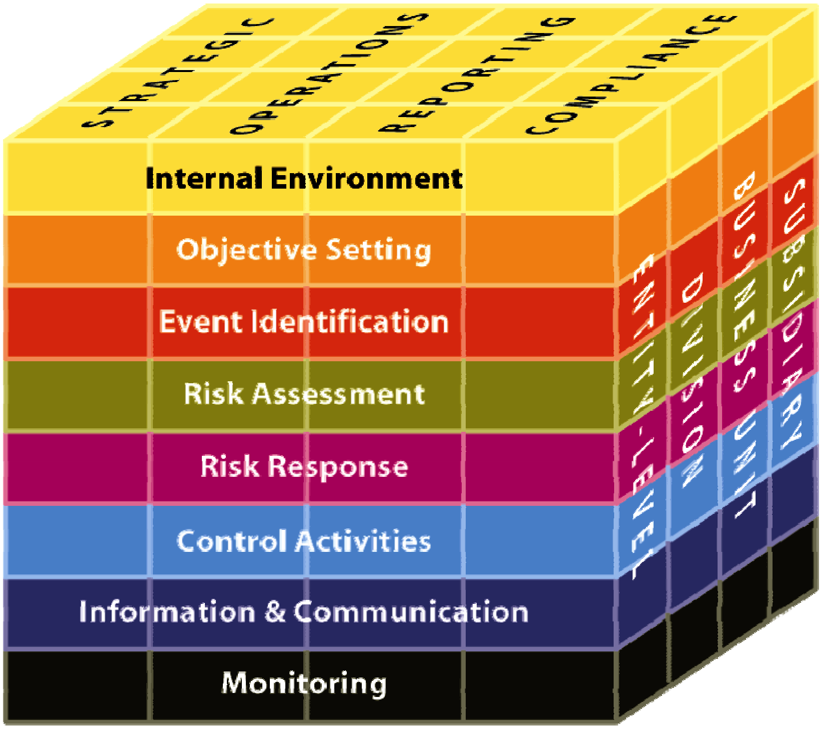

Figure 2.4 The COSO ERM– Integrated Framework

As shown in Figure 2.3, the COSO ERM framework consists of three dimensions. The first dimension consists of the four objectives of the framework including Strategic; Operations; Reporting; and Compliance. The second dimension model identifies the multi-level implementation of the model and comprises: Subsidiary; Business Unit; Division, and Entity-Level.

The third dimension consists of the following eight components:

- Internal environment: Establishing the foundation of an organisational risk management framework.
- Objective setting: Ensuring that the objectives are aligned with company’s strategic goals.
- Event identification: Identifying internal and external factors that may impact the organisation’s strategy and the achievement of objectives.
- Risk assessment: Analysing risks in the operations with an emphasis on both the likelihood and impact of potential events.
- Risk response: Selecting risk responses and developing actions based on risk tolerances set by the organisation.
- Control activities: Establishing and implementing policies and procedures to ensure that risk responses are carried out effectively.
- Information and communication: Disseminating information about risk-related matters to all levels of the organisation.
- Monitoring: Ensuring that all components of the enterprise risk management framework are applied at all levels of the organisation.

Like the AS/NZS 4360 model, a closer look at the COSO model revealed that, it too uses the PDCA methodology as the basis. The first two components 'Internal environment' and 'Objective setting' are the 'Act' phase. The components 'Event identification' and 'Risk assessment' refer to the 'Plan' phase while the component 'Risk response' can be seen as the 'Do' phase of the PDCA cycle. The components 'Information and communication' and 'Monitoring' are the final phase 'Control'.

In summary, the eight components of COSO ERM framework perfectly align with the seven elements of AS/NZS 4360. The only difference between these two models appears to be the fact that the COSO model specifies the top-down implementation of an organisation-wide risk management program.

2.3.2.3 ERM system applications

Like the AS/NZS 4360 framework, the COSO ERM model is generic in nature and could be applied by all organisations, industries and sectors. According COSO, this ERM framework has many benefits to organisations (COSO 2004). However, there seems to be limited research evidence for this and is currently being explored further. A recent survey conducted by the IIA Research Foundation about the benefits of the COSO ERM framework in several countries, including USA, Canada, Europe and Australia, comprising various disciplines, has confirmed that most companies were aware of the COSO ERM framework. However, only 11% of responding organisations had a complete ERM framework in place (cited in Beasley et al. 2005).

Furthermore, a survey conducted by the ANAO showed that most organisations were facing difficulties with the ERM implementations. Some of the common problems mentioned in the survey included the organisational culture and lack of expertise in implementation of the ERM framework (cited in McPhee 2003).

The Enterprise Risk Management (ERM) framework is an alternative option preferred by some organisations (COSO 2004; DeLoach 2000; Hopkin 2002). Like the AS/NZS 4360 framework, due to limited research it is too early to suggest that implementing an ERM model leads to better results in regard to managing operational risks.

2.3.3 ORM systems based on operations management systems

2.3.3.1 Introduction

The idea of reducing losses caused by poor product or service quality through the implementation of a 'standardised' system is not new and can be expanded into other aspects of an operation as well. Currently, various management system standards are available that can help organisations deal with risks in different operations (Brumale & McDowall 1999).

In the past few years, many organisations in Australia and elsewhere implemented environmental and/or safety management systems in addition to their existing quality management system. Like the quality management system, environmental and safety management systems can be certified by a third party using the following standards: ISO 9001:2000 for the quality management system (QMS); ISO 14001:1996 for the environmental management system (EMS); and AS/NZS 4801:1996 for the occupational health and safety management system (OH&SMS).

2.3.3.2 Operations management system frameworks

As shown in Figure 2.5, the ISO 9001 QMS model is a combination of the Input-Process-Output (I-P-O) and PDCA methodologies, and can be used to manage the quality risks (i.e. the risk of poor quality). Similarly, ISO 14001 EMS model shown in Figure 2.6 and AS/NZS 4801 OH&SMS model shown in Figure 2.7 incorporate the PDCA method for managing the environmental risks, and health and safety risks.

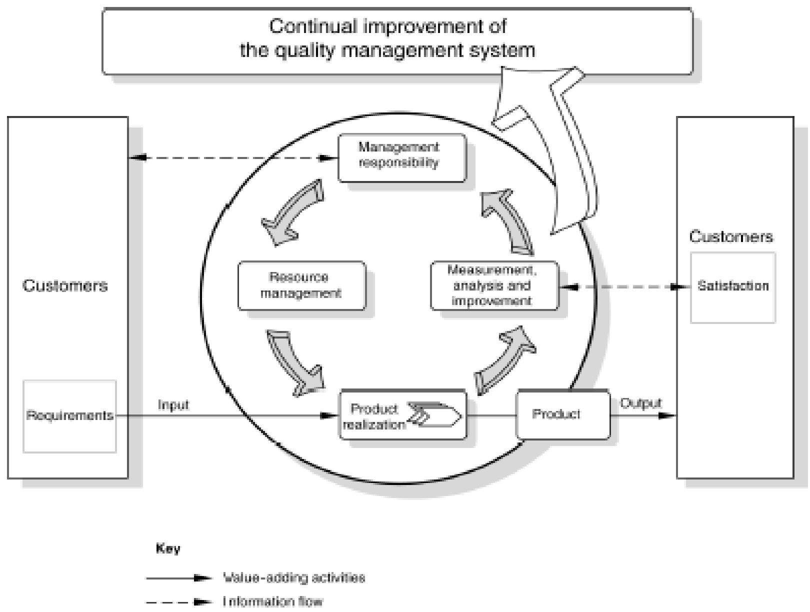

Figure 2.5 The ISO 9001:2000 - Quality management system model

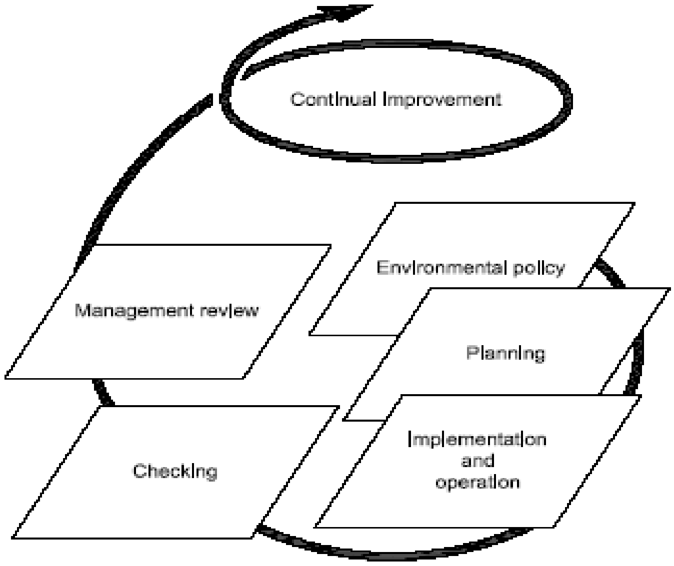

Figure 2.6 The ISO 14000:2004 - Environmental management system model

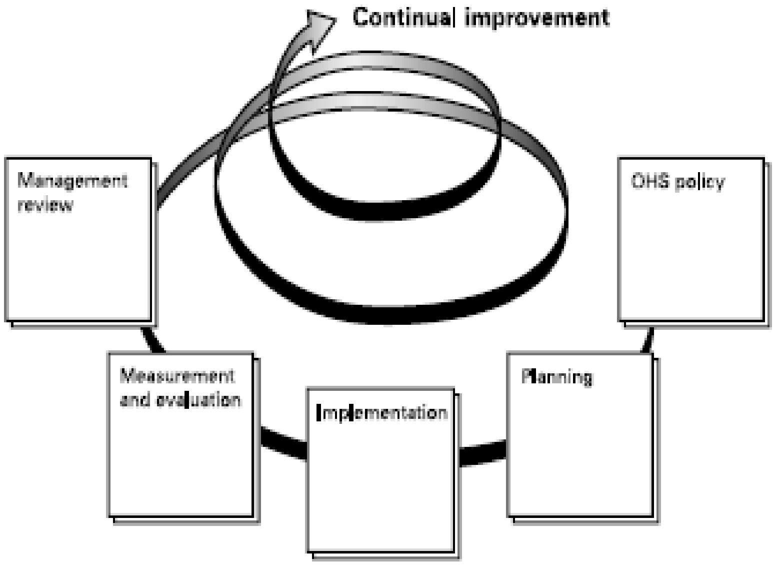

Figure 2.7 The AS/NZS 4801:2001 – Occupational health and safety management system

2.3.3.3 Operations management system applications

According to Brumale and McDowall (1999), the implementation of management systems can be considered as a proactive approach to managing risks and reducing losses. Review of the literature about the quality, environmental and safety management systems reveals that there is a relationship between those management systems practices and the performance of an organisation (QMS (e.g. Gordon & Wiseman 1995; Maani 1994; Sohal et al. 1992), EMS (e.g. Klassen & McLaughlin 1996; Sroufe 2003), and OHSMS (e.g. Lin & Mills 2001; Mohamed 1999)).

The relationship between quality management practice and organisational performance has been discussed widely in the literature. According to the empirical study carried out by Zhang (2000), the quality management practices have a positive impact on operational performance in strategic, processes, suppliers, customers and employees areas. This positive impact also leads to minimise the losses. These findings are consistent with the results of other researchers (Powell 1995; Tena et al. 2001, Terziovski & Samson 1999). They also argue that implementation of quality management practices as a whole shows better effect on overall performance.

Like the quality management practices, the link between environmental management and organisational performance has been also discussed. The findings of research conducted by Sroufe (2003) indicated the positive relationship between environmental management practices and operational performance. This relationship seems to lead to cost savings, market gains, higher material utilisation, and better product quality. As discussed by Lin and Mills (2001), most occupational health and safety research studies have shown that effective safety management leads to reduction of workplace injuries.

Several factors may be responsible for the success of these management system practices. Top management commitment seems to be the most critical factor for success (Klassen & McLaughlin 1996; Lin & Mills 2001; Powell 1995; Sohal & Terziovski 2000; Zhang 2000). Other factors include communication (Sroufe 2003), employee empowerment (Powell 1995), training, involvement and review of the system (Sohal & Terziovski 2000).

In Australia, most organisations use the three management systems as stand-alone rather than as an integrated management system (Hasan & Kerr 2003). According to Terziovski and Samson (1999), however, there is an increasing trend to amalgamate all the management systems into a single integrated management system. A number of benefits, such as minimising cost, reducing duplication, and saving time in the implementation of an integrated management system, have been identified by many researchers (Beechner & Koch 1997; Brumale & McDowall 1999; Jonker & Karapetrovic 2003; Karapetrovic 2003; Karapetrovic & Willborn 1998; Scipioni et al. 2001).

The idea of management system integration became a popular research and discussion topic after the publication of the environmental management system standard ISO 14001 in 1996 (Affisco et al. 1997; Beechner & Koch 1997; Karapetrovic & Willborn 1998). In recent years, the idea of integration has also expanded to occupational health and safety (Scipioni et al. 2001) and other management systems (Jonker & Karapetrovic 2003; Karapetrovic 2003).

2.3.4 Discussions

The following conclusions can be drawn from the discussions and analysis of ORM system standards and frameworks:

- Presently in Australia, most organisations use one of the following three ORM system frameworks: generic risk management systems (AS/NZS 4360), enterprise-wide risk management systems (COSO ERM) or ORM systems based on operations management systems (QMS, EMS and/or OH&SMS).

- A closer look at the discussed models revealed that the three frameworks refer to the PDCA improvement methodology. This is not surprising, as most commonly used business improvement methods and concepts, including TQM and Six Sigma, also share the same PDCA roots.

- Whether stand-alone or integrated, it seems that many organisations face difficulties with the implementation of first two frameworks, namely: generic risk management systems (AS/NZS 4360) and enterprise-wide risk management systems (COSO ERM). In contrast, managing operational risks based on the QMS, EMS and OH&SMS models appears to be more common.

2.4 Summary

This chapter began with a review of the concept and history of ORM systems in the operations management field. The three commonly used ORM systems, including generic risk management systems (AS/NZS 4360), enterprise-wide risk management systems (COSO ERM), and operations management systems (ISO9001, ISO14000, and AS4801), were then reviewed. The frameworks and applications of these ORM systems were also discussed.

The implementation of ORM system for many organisations has not been an easy task. As discussed in this Chapter, has been shown, there is no framework that integrated all approaches to manage operational risk. There is a need for a theoretical model of more effective ORM system implementation. We propose such a model in the next Chapter.

Chapter 3 Research model, propositions and hypotheses

3.1 Introduction

This chapter presents a framework and research model for ORM system implementation in this study. Section 3.2 defines the ORM system framework while Section 3.3 explains the elements of the framework in detail. Section 3.4 discusses the proposed research model. Section 3.5 presents propositions and research hypotheses. Finally, Section 3.6 summarises this chapter.

3.2 Proposed ORM system framework in this study

The extensive literature review suggests that ORM encompasses a vast spectrum of topics and perspectives. Various standards and frameworks have been used for ORM. In fact, the implementation of one or more operations management systems is considered to be a proactive way to manage and reduce operational risks (Akpolat 2004; Gardner & Winder 1997).

In the field of operations management systems, quality management system seems to be the most studied area. There are three commonly referenced articles by Saraph et al. (1989), Flynn et al. (1994) and Ahire et al. (1996). Ahire et al. (1996) recommended that an integration of these three frameworks would be useful for future research. Therefore, this study attempts to develop the elements/factors that relate to ORM system implementation based on the quality management system as well as risk management system implementation.

Table 3.1 Framework comparison

Framework	Elements/factors
Proposed ORM system framework	1: leadership; 2: planning and strategic alignment; 3: implementation; 4: monitoring and continuous improvement; 5: training and performance appraisal; 6: employee involvement and empowerment; and 7: communication.
Risk management system (AS/NZS 4360:2004)	1: review of existing process; 2: risk management plans; 3: top management support; 4: risk management policy; 5: authority and accountability; 6: customise of risk management process; and 7: adequate resources.
Quality management system (Saraph et al. 1989)	1: role of divisional top management and quality policy; 2: role of quality department; 3: training; 4: product/service design; 5: supplier quality management; 6: process management/operating; 7: quality data and reporting; and 8: employee relations.

Table 3.1 Framework comparison (cont.)

Framework	Elements/factors
Quality management system (Flynn et al. 1994)	1: quality leadership; 2: quality improvement rewards; 3: process control; 4: feedback; 5: cleanliness and organisation; 6: new product quality; 7: interfunctional design process; 8: selection for teamwork potential; 9: teamwork; 10: supplier relationship; and 11: customer involvement.
Quality management system (Ahire et al. 1996)	1: top management commitment; 2: customer focus; 3: supplier quality management; 4: design quality management; 5: benchmarking; 6: SPC usage; 7: internal quality information usage; 8: employee empowerment; 9: employee involvement; 10: employee training; 11: product quality; 12: supplier performance.
Quality management system (Malcolm Baldridge National Quality Award (MBQA) and Australian Business Excellence Framework (ABEF))	1: leadership; 2: strategic and planning; 3: customer and market focus; 4: information and knowledge management; 5: people; 6: process management; and 7: business performance results

Table 3.1 shows the framework comparison among the ORM system elements/factors in this study and others researches. The ‘supplier relationship’ and ‘customer involvement’ elements/factors in Flynn et al. (1994) framework, ‘supplier quality

management’ element/factor in the Saraph et al. (1989) framework, ‘customer focus’, ‘supplier quality management’, ‘benchmarking’, and ‘supplier performance’ elements/factors in Ahire et al. (1996) framework and ‘customer and market focus’ element/factor in MBQA and ABEF were not included in this research framework since those elements/factors focused on customer, supplier and competitors which are external to the organisation.

In this study, an ORM system is defined as follows:

“A management system for managing losses in operational processes based on leadership, planning and strategic alignment, implementation, monitoring and continuous improvement, training and performance appraisal, employee involvement and empowerment, and communication.”

3.3 Elements of proposed ORM system framework

3.3.1 Element 1: Leadership

DuBrin (1995) defined leadership as an ability to motivate confidence and deliver supports among those needed to achieve organisational goals. According to Anderson et al. (1994), the main role of top management is to establish, practise, and lead a long-term vision for the organisation. Many management systems studies have identified that the effective management system was directly associated with the role and attitude of top management in the organisation (Klassen & McLaughlin 1996; Lin & Mills 2002; Powell 1995; Pun & Hui 2002; Rahman 2001; Sohal & Terziovski 2000; Zhang 2000). Strong commitment from top management is vital. Brown et al. (1994) points out that lack of top management commitment is one of the reasons for management system failure. However, only top management commitment may not be adequate. Stated vision and policy are also the powerful motivating force that can be used to drive the process (Kanji & Asher 1993). Thus, the concept of leadership in this study can be defined as the ability of top management to lead the organisation to long-term business success.

3.3.2 Element 2: Planning and strategic alignment

Planning is one of the critical and core processes of a system and provides a great potential for identifying and controlling other processes in the system. A strategic plan provides the guidance to accomplish the goals. Alignment of the strategic plan to business strategies is also the major concern for most organisations to achieve the set goals (Akpolat 2004). An ORM plan should define how ORM is to be conducted throughout the organisation. Employees at different levels should be involved in developing the plan, which should be well communicated to all employees (Mann 1992). As a result, their commitment to the realisation of the plan is encouraged.

3.3.3 Element 3: Implementation

The system is defined as the organisation structure, procedures, processes, and resources needed to implement the management (ISO8402 1994). After having established the plan, the organisation should put the plan into action. The implementation of an ORM system means to establish the system according to the plan which is based on the objectives, requirements, benefits and resources of the organisation. Zhang (2000) stated that implementation of the system as a whole shows better on overall performance.

3.3.4 Element 4: Monitoring and continuous improvement

Monitoring is systematic examination used to identify the differences between actual performance and the goal. It offers a starting point for continuous improvement by understanding of the issue and the areas demanding attention. According to Flynn et al. (1994), monitoring and continuous improvement of the system can ensure all processes operate as expected. An important matter in monitoring and improving the system is maintenance of the system to meet goals and targets. Goals and targets can be defined as key performance indicators. Operational performance results are normally used to plan the improvement. In addition, an audit can be used to evaluate the need for standardisation of the system and continuous improvement.

3.3.5 Element 5: Training and performance appraisal

Training refers to the attainment of specific skills or knowledge that educates employees about how to perform their job or activities, while education attempts to provide employees with general knowledge that can be applied in many different situations (Cherrington 1995). Deming (1986) pointed out that it is important to properly train employees in performing their work. They are valuable resources worthy of receiving education and training throughout their career development. Cherrington (1995) also suggested that education and training require systematic approach. It also requires a good performance assessment. Careful analysis of employees' performance provides valuable information to design effective training activities.

3.3.6 Element 6: Employee involvement and empowerment

Employee involvement can be defined as the degree to which employees in an organisation engage in various activities. It can be demonstrated by things such as teamwork, employee suggestions and employee commitment. Deming (1986) points out that teamwork is needed throughout organisations to compensate one's strength for another's weakness. It can be characterised as a cross-functional team and collaboration between managers and non-managers (Dean & Bowen 1994). To have effective employee involvement, employee suggestions must receive serious consideration and be taken into account whenever it is relevant in operations. Deming (1986) and Ishikawa (1985) stated that one way to motivate employees at work is to let them accomplish things and see those things actually work. Lam (1995) also points out that employees committed to their jobs will be motivated to work and provide high performance. To effectively manage the system, employees must be empowered and encouraged to solve the problems they encounter (Deming 1986).

3.3.7 Element 7: Communication

Communication is essential for any organisational initiative, problem identification and change management (Juran & Gryna 1993). It is vital to a success of ORM system program. The employees' responsibilities and awareness should be established and communicated throughout the organisation. Sohal and Terziovski (2000) stated that there should be two-way communication between employees and management regarding ORM matters to ensure the correct decision is made all the time.

3.4 Research model

Through an extensive literature review, a research model was proposed. This research model contains seven elements/factors: leadership; planning and strategic alignment; implementation; monitoring and continuous improvement; training and performance appraisal; employee involvement and empowerment; and communication, which are believed to be the factors that have an affect on ORM system implementation.

As shown in Figure 3.1, those elements/factors are grouped into three fundamental modules: top management module; process management module; and human resource management module.

3.4.1 Module 1: Top management

The top management module represents the role and attitude of top management in implementing the ORM system. In this module, leadership is the main element that drives the whole system to meet or exceed the organisation’s goals.

The roles and responsibilities of top management include:

- committing to the success of an ORM system program
- developing an organisational mission, vision and values
- defining ORM policy and objectives
- driving and communicating ORM system across the organisation
- providing adequate resources and supports for ORM system activities
- reviewing of organisational performance regularly
- establishing appropriate levels of recognition, reward, approval and sanction for risk-related actions.

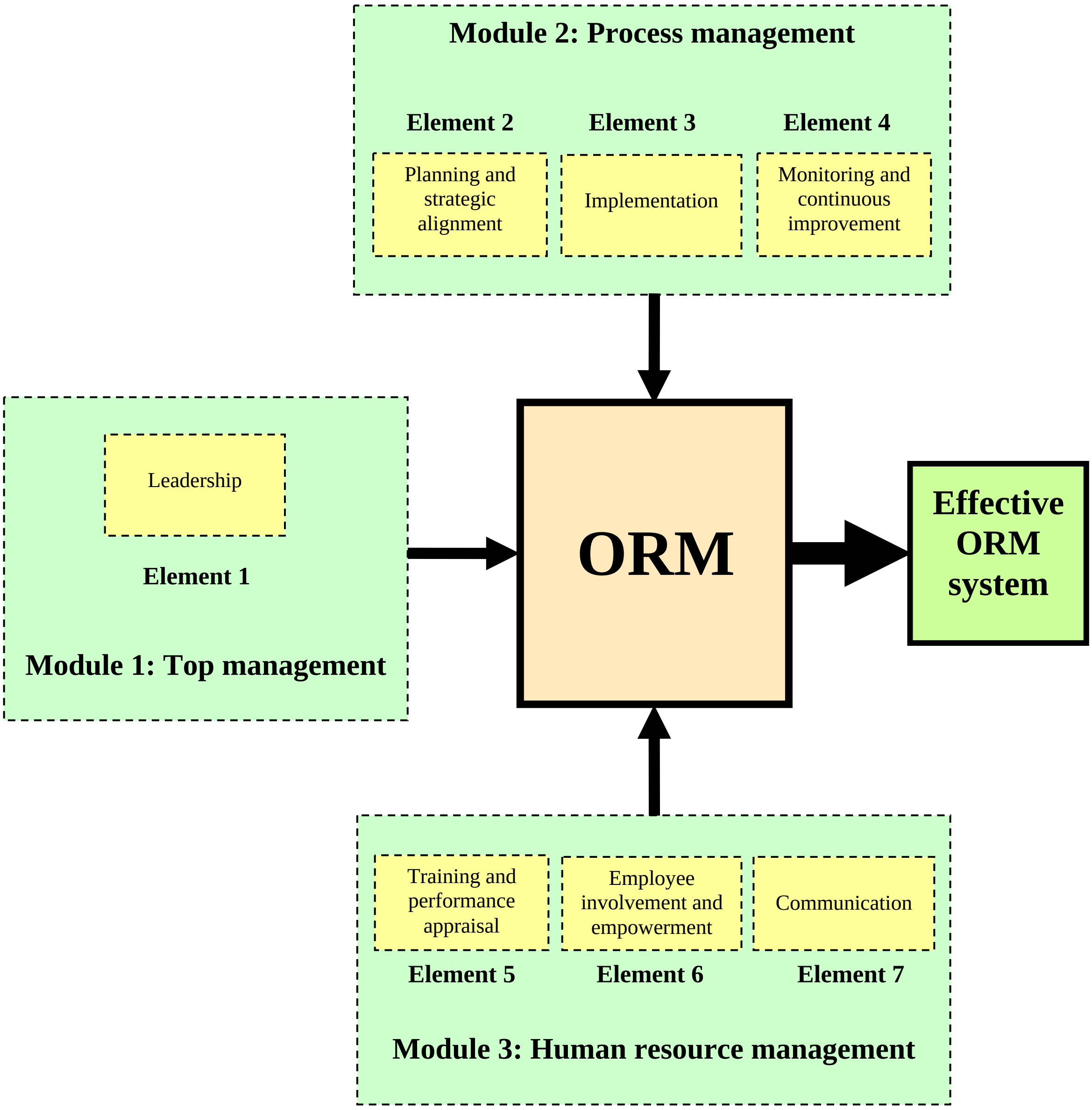

Figure 3.1 The proposed ORM system implementation model

3.4.2 Module 2: Process management

The process management module serves as the core processes of the ORM system that plan, implement and monitor the whole system. It is comprised of three elements: planning and strategic alignment; implementation; and monitoring and continuous improvement.

3.4.3 Module 3: Human resource management

Human resource is the most valued asset for any organisation as people contribute to the achievement of its objectives. Human resource management serves as a mechanism to plan, manage and improve human resources. It is comprised of three elements: training and performance appraisal; employee involvement and empowerment; and communication.

3.4.4 Summary of research model

In the proposed model, the top management model defines objectives, and sets direction and resources to achieve organisation's goals. The process management module sets a plan aligned with business strategies, and executes and continuously improves operational performance, while human resource management module develops and motivates employees to utilise their potential to align with the organisation's objectives and delivers the results.

3.5 Research proposition and hypotheses

According to the literature review, it would appear that the previous research studies have not or insufficiently identified factors in the success of ORM system implementation. The primary purpose of this study is to identify the factors that are related to the success in implementing an ORM system.

Seven factors of ORM system implementation - leadership, planning and strategic alignment, implementation, monitoring and continuous improvement, training and performance appraisal, employee involvement and empowerment, and communication - have been identified in the literature of operation management. Although several studies have discussed the importance of those ORM system factors, none has empirically examined the effects of these factors on ORM system implementation.

Based on the proposed research model in this study and the review of literature, the following propositions and hypotheses were proposed:

Proposition 1: Importance and practice

In Australia, ORM system has been widely implemented due to the organisational awareness of the benefits and advantages of the ORM system. However, some organisations seem to fail to transform that awareness in implementing ORM system effectively.

Hypothesis 1: There is a significant difference between the importance and practice of an ORM system.

Proposition 2: Leadership

Top management has a key role in leading the organisation to long-term success. Top management should be fully committed to ORM and share the vision and direction with all level in the organisation. Leadership and support from top management are the vital ingredients of the implementation of an ORM system.

Hypothesis 2: Leadership has a positive impact on an ORM system.

Proposition 3: Planning and strategic alignment

Planning provides the road map for the achievement of goals. Strategic alignment of the plan can improve resource allocation and encourage employees to focus their attention on achieving clear and specific goals.

Hypothesis 3: Planning and strategic alignment have a positive impact on an effective ORM system.

Proposition 4: Implementation

Implementation of an ORM system should be planned and systematic implementation process. It is essential that all employees take part in the implementation in order to increase their ownership of ORM system.

Hypothesis 4: Implementation has a positive impact on an effective ORM system.

Proposition 5: Monitoring and continuous improvement

Monitoring provides the essential mechanism for the control of an ORM system. It can also be used for continuous improvement of the ORM system practices.

Hypothesis 5: Monitoring and continuous improvement have a positive impact on an effective ORM system.

Proposition 6: Training and performance appraisal

Training can improve employees' knowledge and skills and have important influence on their development. Analysis of employees' performance also provides valuable information to design effective training program for employees. Therefore, employees can generate ideas for solving problems and achieve objectives.

Hypothesis 6: Training and performance appraisal have a positive impact on an effective ORM system.

Proposition 7: Employee involvement and empowerment

Employee involvement and empowerment are required for a successful implementation of the ORM system. The participation of employee in ORM system activities will increase their job satisfaction. Employee satisfaction may also increase if employees are empowered to make suggestions for improvement.

Hypothesis 7: Employee involvement and empowerment have a positive impact on an effective ORM system.

Proposition 8: Communication

Communication is vital to a success of ORM system. Communication channel should be clearly established and ORM awareness need to be communicated at all levels of the organisation.

Hypothesis 8: Communication has a positive impact on an effective ORM system.

Proposition 9: ORM system factors

Leadership, planning and strategic alignment, implementation, monitoring and continuous improvement, training and performance appraisal, employee involvement and empowerment, and communication are the factors of an effective ORM system. They all are interrelated and have an impact on ORM system.

Hypothesis 9: There is a significant interrelationship among the seven factors of an ORM system.

3.6 Summary

Based on the results of the literature review in the previous chapter, the concept of an ORM system in this study was defined. ORM system consists of seven main elements: leadership and commitment; planning and strategic alignment; implementation; monitoring and continuous improvement; training and performance appraisal; employee involvement and empowerment; and communication. The detailed explanations of these elements were also described. Then, the research model for ORM system implementation was proposed. The model consists of three modules which are: top management module; process management module; and human resource management module. Finally, the research proposition and hypotheses in this study were presented. The next chapter will be demonstrated the research methodologies employed to evaluate the proposed research model, propositions and hypotheses for ORM system implementation.

Chapter 4 Research method

4.1 Introduction

This chapter describes the research methodology employed in carrying out this research. Section 4.2 presents an overview of the systematic approach used for this research. Section 4.3 provides a theoretical foundation of this study, while Section 4.4 discusses research design. Section 4.5 discusses the method of data collection. Section 4.6 provides the detail of implementation method including population and sample selection, sample size, questionnaire development, pilot testing, ethics approvals, web-based survey, response rate improvement, and data entry and data checking. Section 4.7 presents data analysis methods for preliminary data analysis, hypotheses testing, reliability testing, and validity testing. Finally, Section 4.8 summarises this chapter.

4.2 Systematic approach for this study

Based on a systematic approach for empirical research methods in operations management recommended by Flynn et al. (1990), this research is structured into a five-stage study: establish the theoretical foundation; select a research design; select a data collection method; implementation; and data analysis. Table 4.1 presents an overview of the structure with brief research methodology for each stage of this research.

Table 4.1 The structure of the research methodology of this study

Stage	Activity
Theoretical foundation	Descriptive study and theory verification study
Research design	Questionnaire survey
Data collection method	Quantitative and qualitative methods
Implementation	Population and sample selection Sample size Questionnaire development Pilot testing Ethics approval Web-based survey Response rate improvement Data entry and data checking
Data analysis	Preliminary data analysis and hypotheses testing Reliability testing Validity testing

4.3 Theoretical foundation

This study can be considered as both a descriptive study and theory verification study. A descriptive study is generally concerned with making complicated things understandable (Punch 2000). Since the study used a literature review to identify the concept of ORM and to provide a detail understanding of the status of ORM systems today in terms of its research and its application, it can be argued that this stage of the study is a descriptive study. After the research hypotheses were generated from the literature and tested using the quantitative results, this study moved further to explain as a theoretical verification study which focused on testing of the hypotheses (Flynn et al. 1990).

4.4 Research Design

A web-based questionnaire survey was used to obtain information from a wide range of Australian organisations about ORM system practices and opinion on critical success factors of an effective ORM system implementation.

The questionnaire was chosen for this research because it is a convenient and inexpensive method that can cover a wide geographical area compared to other methods (Cooper & Emory 1995). Therefore, the collection of data from respondents who were located all over Australia could be made simpler. Furthermore, this method was favoured by respondents, as the questions are likely to be easy to understand and convenient to response at their own pace and time (Sekaran 2003). Kumar (2005) also pointed out that the questionnaire method provides greater anonymity which could help to increase the accuracy of information obtained in some situations where sensitive questions are asked.

Using a questionnaire as a web-based survey generally yields higher response rates compared to other questionnaire survey techniques. However, finding and selecting representative samples in electronic surveys could be the problematic area (Williamson 2002). Details of the techniques for selecting valid representative samples and improving the rates of response will be discussed in Section 4.6.

4.5 Data collection method

Qualitative and quantitative methods are normally used for collecting data in empirical research. The qualitative method generally assists researchers to understand in-depth and detailed descriptions of phenomena being studied (Yin 1984). Even though the qualitative method provides a wealth of detailed information with a small number of cases involved, it tends to generalise and be less useful for testing hypotheses among variables (Ott 1989). The quantitative method, on the other hand, is a structured methodology that allows researchers to quantify the extent of phenomena being studied. It also provides a generalisable set of findings based on statistical analysis which is fairly reliable (Kumar 2005). Therefore, the quantitative method is more appropriate for generalisation and hypotheses testing.

Based on the theoretical foundation of this study, the quantitative method was mainly used to design most questions in the questionnaire. However, some open-ended questions were included in the questionnaire to collect qualitative data from the respondents to get additional comments and strengthen research design by using both quantitative and qualitative approaches.

4.6 Implementation

4.6.1 Population and sample selection

According to Cooper and Emory (1995), the population can be determined from the objectives and the problem addressed in the research. Based on the objectives in this study, the population covered small, medium, and large Australian business organisations which were certified to one or more operations management system standards. However, collecting the data from every certified organisation in Australia would have been extremely expensive and time consuming. Thus, the potential representative samples were drawn from the Joint Accreditation System of Australia and New Zealand (JAS-ANZ) database in conjunction with Kompass (an electronic database of Australian businesses). The JAS-ANZ database provides the list of certified organisations, certified standard, and certified year, while the Kompass database provides the organisation’s details including name, number of employees, annual revenue, contact person, postal address, email address, website and telephone number.

For this sampling frame, the selection of potential respondent organisations for investigating ORM system implementation was undertaken on the basis of the number of employees. Business organisations that had fewer than ten employees were excluded from the sample. They may be termed as very small or micro business organisations. The reason for their exclusion was that the practice of systematic management system might not be carried out in very small or micro businesses. In addition, the annual revenue was not included for this consideration because the annual revenue might not be the main concern for the practice of systematic management system.

4.6.2 Sample size

Based on the data of 2005 in JAS-ANZ database, there were about 15,000 organisations certified to one or more management system standards. As recommended by Cooper and Emory (1995), the sample size was decided by considering time, resources, expected response rate and requirements for statistical analysis. A sample was obtained of 450 organisations randomly selected from the JAS-ANZ database and matched with the contact details listed in Kompass.

4.6.3 Questionnaire development

The development of a suitable and reliable questionnaire is one of the major tasks in empirical research. According to Fowler (1993), designing good questionnaires should include carefully wording the questions. In particular, the questions should be clear, simple and straightforward.

In the field of operations management, a number of researchers have employed questionnaire surveys as tools to collect data (e.g. Flynn et al. 1994; Whybark 1997; Sohal & Terziovski 2000). The questionnaires developed by these researchers gave some insights into developing the questionnaire in this study. However, the design of this research questionnaire was mainly developed from the theoretical constructs in this study.

The questionnaire developed in this study consisted of two sections: Section 1 – General organisation information; and Section 2 – Success factors for operational risk management systems.

Section 1 – General organisation information

This section consists of questions related to general characteristics of the respondents, which include each respondent's department, industry type and organisation size. The list of industry types followed ANZSIC (Australian and New Zealand Standard

Industrial Classification) obtained from the ABS (Australian Bureau of Statistics). In addition, questions related to the overview of operational risk management used in each respondent's organisation also included.

Section 2 – Success factors for operational risk management systems

This section consists of 28 statements which were designed to collect a respondent's perception of the ORM system factors implemented in his or her organisation, and opinion of the importance of those factors to an effective ORM system implementation. The statements were developed from the seven ORM system factors presented in chapter 3 which are believed to be the factors that have an effect on ORM system implementation (see Table 4.2).

Respondents were asked to rate each statement on a five-point Likert scale. For the 'IN MY ORGANISATION' section, the scales ranged from (1) to (5) with (1) = 'Strongly Agree', (2) = 'Agree', (3) = 'Neutral', (4) = 'Disagree' and (5) = 'Strongly Disagree'. For the 'IMPORTANCE' section, the scale ranged from (1) to (5) with (1) = 'Not Important At All', (2) = Not Important, (3) = 'Average Important', 4 = 'Important' and (5) = 'Vital'.

Table 4.2 ORM system factors vs. Questionnaire statements

Module	ORM system factor	Questionnaire statement
Top management	Leadership	Q12. Top management and leadership are committed to the success of an operational RMS program.
		Q14. Clearly defined operational RMS objectives are tied to the business objectives.
		Q15. The organisation has a defined and documented operational RMS policy.
		Q17. Top management drives and champions operational RMS across the organisation.
		Q18. Top management provides adequate resources for operational RMS activities.
		Q33. Regular reviews of organisational performance are conducted to assess progress toward achievement of operational RMS objectives.
		Q36. Appropriate levels of recognition, reward, approval and sanction for risk-related actions are established.
Process management	Planning and strategic alignment	Q10. Operational RMS is viewed as a critical tool in managing our business processes.
	Implementation	Q11. Operational RMS helps an organisation to minimise losses and business opportunities.
		Q13. Operational risks are included in the strategic decision-making process.
	Monitoring and continuous improvement	Q21. Operational RMS plans are consistent with operational RMS policies and linked to the strategic business plan.

Table 4.2 ORM system factor vs. Questionnaire statements (cont.)

Module	ORM system factor	Questionnaire statement
Process management	Implementation	Q19. Management of operational risks is carried out in a systematic and repeatable manner.
		Q20. Management of operational risks are integrated and embedded into the organisation's philosophy, practices and business processes.
		Q23. Formal systems and procedures for operational RMS are implemented throughout the organisation.
		Q31. Risk management process is used for problem solving, in which problems are recognized, prioritised, and actions taken to resolve them.
	Monitoring and continuous improvement	Q32. Key performance indicators for operational RMS performance have been identified.
		Q34. Operational performance results are used to plan improvement.
		Q35. Risk management information systems are used to record, track, and monitor risk management activities.
HR management	Training and performance appraisal	Q29. Employees and management have appropriate operational risk assessment and management skills.
		Q30. Employees and management receive appropriate training.
		Q37. Operational RMS related performance is part of staff appraisal and performance management system.

Table 4.2 ORM system factors vs. Questionnaire statements (cont.)

Module	ORM system factor	Questionnaire statement
HR management	Employee involvement and empowerment	Q25. The implementation of the operational RMS had the involvement of, and consultation with, everyone in the organisation.
		Q26. Employees participate in organisation-wide operational RMS activities.
		Q27. Employees are empowered and have the authority to deal with operational risks.
		Q28. Teamwork and involvement are normal practices.
	Communication	Q16. Operational RMS policy is understood, implemented and maintained at all levels of the organisation.
		Q22. Operational RMS responsibilities are established and communicated to all levels of organisation.
		Q24. Awareness about management of operational risks exists throughout the organisation.

4.6.4 Pilot testing

The main purpose of pilot testing is to ensure the feasibility of the questionnaire and test the reliability of the scales (Sekaran 2003). For this purpose, copies of the questionnaire were distributed to three academics at University of Technology Sydney to comment on instructions, length, question sequence and question transformation of the questionnaire. The feedback given from the academics were used for rectifying and improving the questionnaire. The main issues highlighted were the wording used for instructions and statements under the ‘success factor’ section. Some new statements were added and any duplicated statements were eliminated. After modification, the questionnaire was emailed to 40 practitioners familiar with ORM system implementation asking them to response to the questionnaire. The respondents were also asked to comment on the structure and clarity of the questionnaire. A total of 32 were returned, a response rate of 80%.

According to Sekeran (2003), a minimum sample size of 30 is required for 450 sample population to conduct the statistical analysis. Therefore, 32 completed questionnaires of this pilot study were sufficient to conduct the reliability test. The internal consistency using Cronbach’s alpha model was carried out to test reliability of the scales. The Cronbach’s alpha value for the ‘Practice’ scale was found to be 0.947 and for the ‘Implementation’ scale was 0.951. In most cases, a value of greater than 0.7 would normally indicate high internal consistency (Hair et al. 1998). Thus, reliability of the scales in this questionnaire was more than adequate. Moreover, no major comments were given in this pilot study, therefore no changes were made. The final version of the questionnaire is presented in Appendix 1.

4.6.5 Ethics approval

It is a requirement at University of Technology Sydney (UTS) that all research studies involving human subjects must have written approval from the UTS Human Research Ethics Committee (HREC) in order to meet Commonwealth legislative requirements in Australia. Thus, the researcher has a responsibility to ensure that written ethics approval is obtained before commencing data collection.

To comply with this requirement, a completed application form along with copies of the cover letter and questionnaire were forwarded to the UTS Human Research Ethics Committee for approval. The written approval from the committee was given to conduct the survey after reviewing the proposed research protocol and there were no changes required to the questionnaire. A copy of the approval letter is in Appendix 2.

4.6.6 Web-based survey

The email containing the URL link of the online survey was mailed out to the 450 organisations identified from the JANZS and Kompass electronic databases. A copy of the email is provided in Appendix 3.

The content of the email mainly explained the brief description of operational risk management defined in this study, purpose of the research, the researcher and her supervisor and the estimated time required to fill out the questionnaire. The email was addressed to management representative(s) of the organisations who were familiar with operations management systems. A management representative was preferred as a key respondent because it was assumed that she or he could be the most relevant person having the knowledge in operations management system implementation.

4.6.7 Response rate improvement

Initially, a total of 61 completed questionnaires were received. Reminder letters were emailed to the organisation, resulting in 10 more completed questionnaires. At this stage, the response rate was considered somewhat low in comparison to other survey research studies.

Follow-up telephone calls to management representatives of the potential respondents were made. Telephone calls were usually answered by a secretary, and the researcher was asked to re-send the official letter with UTS letterhead to them again by providing the receiver's name and address. Thus, the official letters were sent by post to selected organisations. As weeks progressed, the number of respondents increased to a total of 136.

4.6.8 Data entry and data checking

A preliminary data analysis using SPSS Version 15 statistical analysis package was carried out. A coding sheet as shown in Appendix 4 was developed to assist the data entry process. The accuracy of data entry was checked with substantial effort.

A total of 136 questionnaires were returned with 75% (102/136) fully completed and no missing data. The maximum percentage of missing data as shown in Appendix 5 for any item was 5.9% (8/136). With this level of missing data, there were no returned questionnaires eliminated from the analysis and omit case option was used to handle missing data.

4.7 Analysis of data

4.7.1 Preliminary data analysis and hypotheses testing

The statistical analysis package SPSS Version 15 was used to analyse the collected data. Preliminary data analysis was performed using descriptive statistics (e.g. mean, standard deviation and frequency distribution) before conducting tests of hypotheses. Parametric tests, including *t*-test and Pearson correlation, were employed for testing the research hypotheses. The *t*-test was used to see whether there was any significant difference in the means of the two groups in the variable, while the Pearson correlation was used to see whether there was any positive (negative) relationship between two variables (Forza 2002).

To meet the purpose and test the theoretical model hypothesised in this study, the measurement instrument should also be reliable and valid. Thus, the reliability and validity tests should be performed. In the following subsections, reliability and validity tests are discussed.

4.7.2 Reliability testing

According to Hair et al. (1998), reliability refers to the extent to which an instrument can produce consistent measurement results in what it is intended to measure in repeated trials. There are three commonly used methods to estimate reliability: test-retest method; alternative or parallel form method; and internal consistency method (Cooper & Schindler 1998).

a) Test-retest method

Test-retest method measures the consistency between the responses with the same measure applied to the same respondents at different points in time. Its objective is to ensure the ability of the measure is not too varied over time.

b) Alternative or Parallel form method

Alternative or Parallel form method measures the consistency between the responses, with the two equivalent forms of the same measures applied to the same respondents at different points in time. Its objective is to evaluate the different sets of items for measuring the same construct.

c) Internal consistency method

Internal consistency method measures the consistency among the variables in the summated scales, and the individual items of the scale should all measure the same construct (Churchill 1979; Nunnally 1979). Nunnally (1979) points out that Cronbach's alpha is the most commonly used measure for internal consistency. The Cronbach's alpha, or coefficient alpha, is a basic measure for reliability, and its value can range from 0 to 1. A value greater than 0.7 would normally indicate high internal consistency (Hair et al. 1998).

As mentioned above, Cronbach's alpha is the most widely used measure and well supported by statistical packages. Thus, internal consistency using Cronbach's alpha was employed to assess the reliability of the research instrument in this study. A Cronbach's alpha value of 0.7 or above is judged as adequate for research purposes.

4.7.3 Validity testing

Validity refers to the extent to which an instrument correctly represents the concept of the study. Validity is generally concerned with how well the concept is defined. According to Sekaran (2003), three types of validity tests are commonly used which are content validity, construct validity and criterion-related validity.

a) Content validity

Content validity refers to the extent to which the measure reflects an entire domain of the subject or construct of interest. It is a subjective assessment method which cannot numerically evaluate the survey instrument's accuracy. The evaluation of content validity mainly involves a panel of content experts to ensure that only appropriate contents are included. The content validity of this research instrument was evaluated by the extensive literature review and pilot study.

b) Construct validity

Construct validity refers to the extent to which an instrument measures what it is designed to measure, and to which proper identification of independent and dependent variables were included in the investigation. Convergent validity and discriminant validity are the most accepted forms of construct validity. Convergent validity assesses the correlation between the two measures of the same construct, while discriminant validity assesses the separation between the two measures of different constructs (Forza 2002). The construct validity of this research instrument was evaluated using factor analysis. An item loading of 0.3 or above is acceptable for convergent validity, and eigenvalues of 1.0 or above are acceptable for discriminant validity.

c) Criterion-related validity

Criterion-related validity refers to the extent to which an instrument is related to a relevant independent measure of a relevant criterion. In the case of this research instrument, the perception of ORM system factors placed by the organisations as 'practice data' were used as independent variables, while the mean of 'importance data' for each respondent served as the dependent variable. Multiple regression analysis was used to determine whether the ORM system factors (practice data) were related to effective ORM system (importance data). According to Hair et al. (1998), correlation coefficient value can range from -1 to +1, +1 indicating a perfect positive relationship, 0 indicating no relationship, and -1 indicating a negative or reverse relationship.

4.8 Summary

This chapter has presented the research methodology adopted in this study which was structured in five stages: Establish the theoretical foundation; Select a research design; Select a data collection method; Implementation; and Data analysis. Based on the research objectives, this research is both a descriptive study and theory verification study. A web-based questionnaire survey was chosen as an instrument for this research to obtain information from a wide range of Australian organisations about ORM system practices and opinion on critical success factors of effective ORM system implementation. In particular, the questionnaire used in this study was mainly developed from the theoretical constructs in this study. A combination of qualitative and quantitative methods was used for data collection. A pilot study was carried out to ensure the feasibility of the questionnaire and to test reliability of the scales. The feedback from the pilot study was used to improve the questionnaire. To get valid representative samples for this study, a random sampling method was employed to select a sample of 450 organisations from the JAS-ANZ database in conjunction with the Kompass database. Before conducting the main survey, written ethics approval was obtained. The URL link of the web-based questionnaire was then emailed to 450 organisations. The initial response rate was considered somewhat low in comparison to other survey research studies. Follow-up telephone calls were made and reminder letters were sent by post to selected organisations to increase the response rate. Finally, this increased the final response rate to an acceptable level for this study.

Data entry and data checking methods to minimise the error were also discussed. Moreover, the procedures for preliminary data analysis, testing research hypotheses, and testing the reliability and validity of the instrument have been described in greater detail in this chapter. The following Chapter will discuss the results of this study.

Chapter 5 Survey results and discussion

5.1 Introduction

This chapter presents the results of this research survey. Section 5.2 describes the generic background of respondents. Section 5.3 addresses the reliability test of the ORM implementation instrument, while Section 5.4 presents the results of the validity testing. Section 5.5 provides the result of ORM system implementation and determines the critical success factors for effective ORM implementation. Section 5.6 presents the research hypotheses analysis result. Section 5.7 discusses general conclusion gathered from the survey and the guideline for ORM system implementation. At the end of this chapter, Section 5.8 provides the summary.

5.2 General characteristics of respondents

As outlined in the research methodology chapter, this study focused on small, medium and large Australian business organisations which were certified to one or more operation management system standards. The samples were selected mainly from the JAS-ANZ database in conjunction with the Kompass. The URL link of the web-based questionnaire was originally emailed to 450 organisations. A total of 29 were returned or not received by the target respondents due to discrepancies of email address, or refusal of respondent to participate, thus reducing the sample to 421. A total of 71 completed questionnaires were received. This yielded a response rate of 16.9% (71/421). This response rate was somewhat low in comparison to other survey research studies. Follow-up telephone calls were made and reminder letters were sent by post to selected organisations to increase the response rate. This increased the final response rate to 32.3 % (136/421), which was considered to be reasonable and acceptable for this study. The results of this study were analysed using the statistical package SPSS Version 15.

5.2.1 Background of respondents

5.2.1.1 Size of responding organisations

The first aspects to be analysed was the general information of the respondents. There is no universal method to ascertain the size of organisation. Number of employees and the annual revenue are commonly the two indicators used. In this study, however, only the number of employees was used. As discussed in the research methodology chapter, the annual revenue might not be the main concern for the practice of systematic management systems.

Table 5.1 shows the breakdown of the respondents based on the size of the organisations. Large organisations having 200 employees or more constituted the largest proportion (81.7 %) of the respondents. A total of 13.2% of the organisations were medium-sized employing between 20 and 199 employees, while small organisations having fewer than 20 employees represented 5.1% of the total. This demonstrates that ORM practices are not limited to size of the organisation. ORM is implemented by large organisations as well as small and medium-sized organisations.

Table 5.1 Size of organisation

Size of organisation	**No. of respondents**	**%**
Small (< 20 employees)	7	5.1
Medium (20 – 199 employees)	18	13.2
Large (200 – 499 employees)	8	5.9
Large (> 499 employees)	103	75.7
Total	136	100

5.2.1.2 Type of industry

As shown in Figure 5.1, the overwhelming majority (89.7%) of respondents were in non-manufacturing industries. Only 10.3% were in the manufacturing industry. This result corresponds with other Australian business statistics, as the majority of Australian businesses operate in the non-manufacturing field.

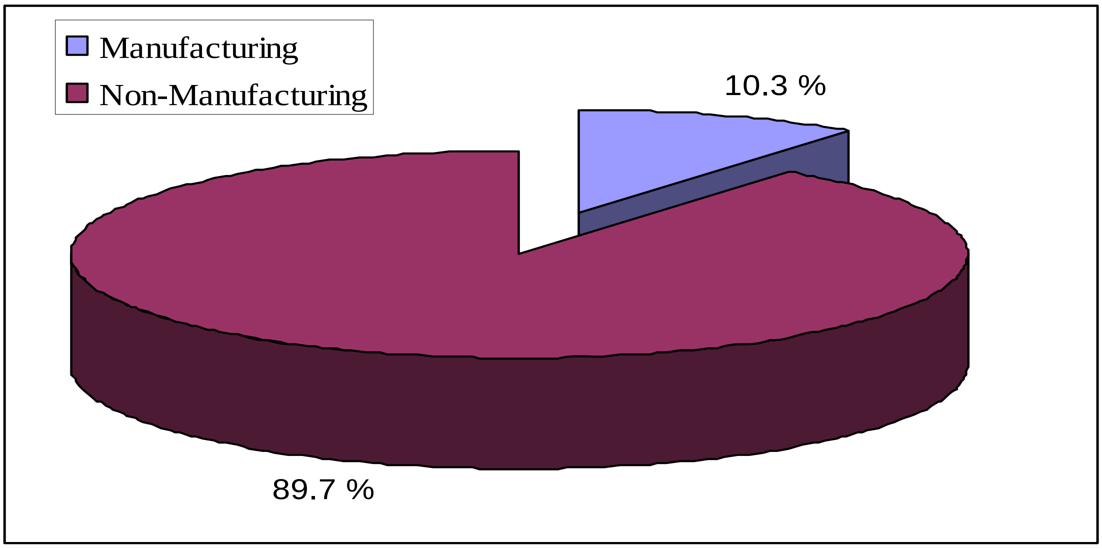

Figure 5.1 Breakdown of industry

5.2.2 Status of respondents' ORM system practices

As it was the objective of this study to discover where Australian organisations are in managing operational risks, the questions in section 1 were designed to capture what ORM activities had been implemented in the organisations.

One of the key findings was that most respondent organisations (94.9%) had risk management policies or procedures in place. In addition, a large number (91.9%) of respondents were employing one or more management system standards as guidelines for their ORM system practices. This is in line with the literature review and the findings of other research studies in the ORM field.

5.2.2.1 Use of management system standards for ORM systems

Figure 5.2 shows the use of various management system standards as a basis for ORM system practices in Australian organisations. It seems that ISO 9001 (quality management standard) was the most favourable standard (72%). It was not surprising if we consider that ISO 9001 is the most commonly implemented management system standard in Australia and the world. Among the other standards, AS/NZS 4360 (risk management standard) (59.2%), ISO 14000 (environmental management standard) (58.4%), and AS/NZS 4801 (occupational health and safety management standard) (58.4%) were the alternative for many organisations. The use of COSO (3.2%) and other standards (9.6%) seems relatively negligible. This was not surprising, as the results of other research studies discussed in Section 2 literature review show similar findings.

5.2.2.2 Integration of management system standards

The survey findings also show that a large number of respondent organisations (94.1%) used management system standards as an integrated rather than stand-alone approach as depicted in Figure 5.3. Approximately 32.4% of respondents fully integrated their management system standards. A majority of organisations (61.8%) were moving toward the amalgamation of all the management systems into a single integrated management system.

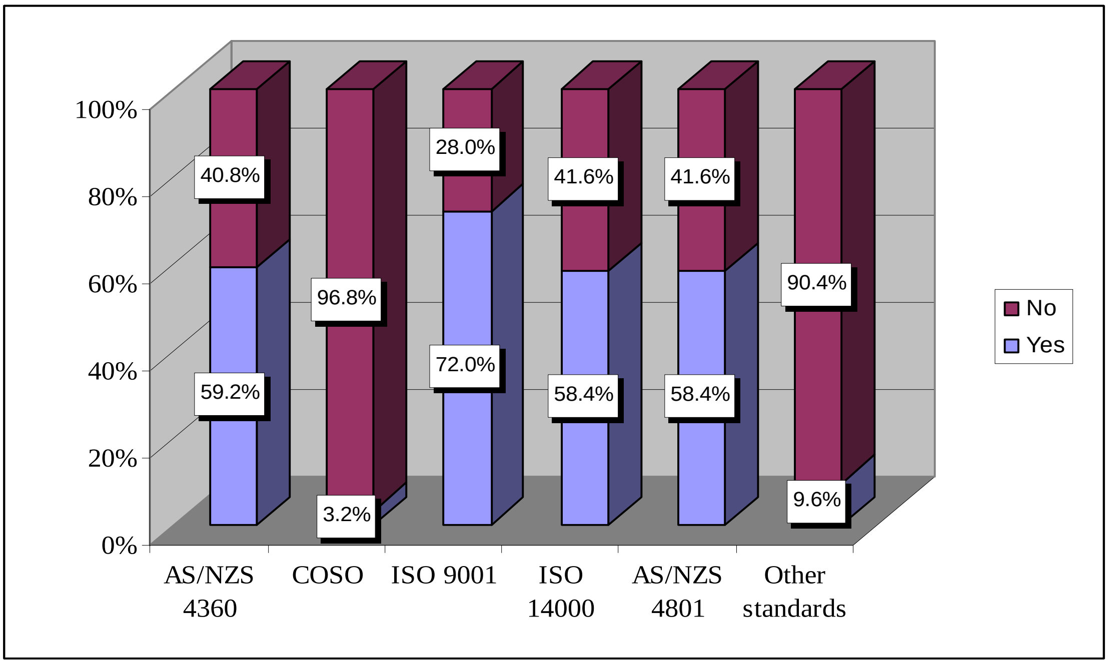

Figure 5.2 Use of management system standards for ORM systems

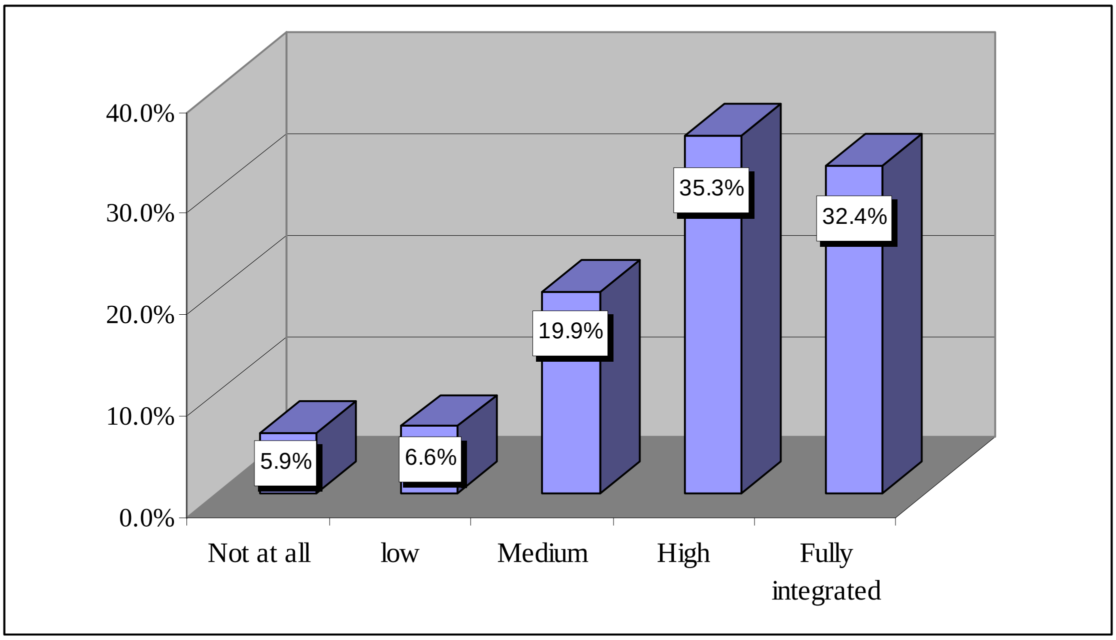

Figure 5.3 Management system integration

5.3 Testing reliability of responses

Internal consistency using Cronbach's alpha model was employed to assess the reliability of the research instrument. The Cronbach's alpha, or coefficient alpha, is a basic measure for reliability, and its value can range from 0 to 1. In most cases, a value greater than 0.7 would normally indicate high internal consistency (Hair et al. 1998).

Table 5.2 Internal consistency analysis results

Factors	Number of items	Reliability of construct	Potential item for elimination
F1. Leadership	7	0.869	None
F2. Planning and strategic alignment	4	0.819	None
F3. Implementation	4	0.859	None
F4. Monitoring and continuous improvement	3	0.736	None
F5. Training and performance appraisal	3	0.740	None
F6. Employee involvement and empowerment	4	0.827	None
F7. Communication	3	0.838	None

In the case of the research instrument, a five-scale instrument was used to measure the seven ORM factors (or constructs). Each factor consisted of several items. SPSS reliability analysis program was performed for the items of each factor separately. Table 5.2 presents Cronbach's alpha values for different ORM factors. This table shows that reliability coefficients ranged from 0.736 to 0.869, indicating that all the factors are satisfactory. Thus, the instrument developed for measuring ORM constructs was considered to have high internal consistency and reliability.

5.4 Testing validity of responses

To validate the survey instrument, three types of validity tests recommended by Sekaran (2003) – content validity, construct validity and criterion-related validity – were performed in this study.

5.4.1 Content validity

Content validity refers to the extent to which the measure reflects an entire domain of the subject or construct of interest. It is a subjective assessment method which cannot numerically evaluate the survey instrument's accuracy. The evaluation of content validity mainly involves a panel of content experts to ensure that only appropriate contents are included (Sekaran 2003).

In the case of the research instrument, the seven ORM factors (or constructs) were developed mainly on the basis of an extensive literature review in operational risk management systems and standards. The detailed process of developing the research questionnaire was addressed in the research methodology chapter. In addition, content evaluation and the pilot study of the research instrument were performed by academics and practitioners. Therefore, it is strongly believed that the research instrument for measuring ORM factors (constructs) has content validity.

5.4.2 Construct validity

Construct validity refers to the extent to which an instrument measures what it is designed to measure, and to which proper identification of independent and dependent variables were included in the investigation. The construct validity of this research instrument was evaluated using principal component factor analysis. A SPSS data reduction procedure was performed for the items of each factor separately. The ‘practice’ data placed by the respondents was used for this analysis. The results are shown in Table 5.3 and the detailed output of factor analysis is provided in Appendix 6.

From the results obtained, all of the items had factor loadings greater than 0.50 and eigenvalues greater than 1. It was clear that all factors are uni-factorial and none of the items was removed. After conducting this analysis, it can be seen that the research instrument for measuring ORM factors has been validated for construct validity.

Table 5.3 Construct validity analysis results

Factors	Eigen-values	Variance explained (%)	Item for elimination	Initial factor loading for Component 1
F1. Leadership	3.941	56.293	None	0.636 – 0.811
F2. Planning and strategic alignment	2.599	64.975	None	0.744 – 0.837
F3. Implementation	2.281	70.518	None	0.799 – 0.873
F4. Monitoring and continuous improvement	1.965	65.511	None	0.781 – 0.841
F5. Training and performance appraisal	2.000	66.650	None	0.737 – 0.854
F6. Employee involvement and empowerment	2.632	65.794	None	0.738 – 0.862
F7. Communication	2.267	75.580	None	0.860 – 0.879

5.4.3 Criterion-related validity

Criterion-related validity refers to the extent to which an instrument is related to a relevant independent measure of a relevant criterion. In the case of this research instrument, multiple regression analysis was used to determine whether the ORM factors were related to effective ORM systems. SPSS regression analysis procedure was performed for this evaluation. The ORM system factors placed by the organisations as 'practice data' were used as independent variables, while the mean of 'importance data' for each respondent served as the dependent variable. The multiple correlation coefficient computed for the seven factors and a measure of effective ORM system was found to be 0.628 (the detailed analysis is shown in Appendix 7), indicating that the seven factors have a reasonably high degree of criterion-related validity when taken together.

After these validity tests, it can be concluded that the research instrument is reliable and capable of measuring what it intended to measure.

5.5 Result of the ORM survey

After the research instrument has tested the reliability and validity, the means for the perception of practice and importance were analysed. Several descriptive statistics were calculated for all items. As discussed in the research methodology chapter, the missing responses were excluded from the analysis. Mean and standard deviation measures were calculated for all items.

5.5.1 Perceptual responses to ORM practices

The level of practice of each ORM system factor was the other aspect for investigation. The overall means of practice perceived by the respondents are shown in Table 5.4. The values range from 3.88 to 3.06 which correspond to the moderate level of practice. From the table, 'Planning and strategic alignment' was found to be the highest 'practice' factor. 'Implementation' and 'Leadership' were found to be the second and the third 'practice' factors, respectively while 'Training and performance appraisal' was found to be the lowest 'practice' factors. It can be concluded that there was diversity in the mean and standard deviations of seven factors.

Table 5.4 Mean practice results

Factor	Description	Mean	Std Dev.	Ranking
F1	Leadership	3.53	1.15	3
F2	Planning and strategic alignment	3.88	1.01	1
F3	Implementation	3.56	1.05	2
F4	Monitoring and continuous improvement	3.37	1.13	4
F5	Training and performance appraisal	3.06	1.10	7
F6	Employee involvement and empowerment	3.24	1.16	6
F7	Communication	3.32	1.09	5

5.5.2 Perceptual responses to ORM importance

Table 5.5 shows the results of overall mean for each ORM system factor which determine the level of importance perceived by respondents. The values range from 4.18 to 4.40, which fall between important and very important. 'Planning and strategic alignment', 'Communication', and 'Leadership' were perceived to be the top three most 'importance' factors, while 'Employee involvement and empowerment' was found to be the least 'important' factor. However, there were only small different of the mean and standard deviations indicating that there is general agreement on the seven factors of ORM system.

Table 5.5 Mean importance results

Factor	Description	Mean	Std dev.	Ranking
F1	Leadership	4.27	0.80	3
F2	Planning and strategic alignment	4.40	0.70	1
F3	Implementation	4.20	0.77	5
F4	Monitoring and continuous improvement	4.22	0.81	4
F5	Training and performance appraisal	4.20	0.84	5
F6	Employee involvement and empowerment	4.18	0.84	7
F7	Communication	4.34	0.75	2

5.6 Testing Research Hypotheses

Hypothesis 1: There is a significant difference between the importance and practice of an ORM system.

From the results obtained in previous section, it can be seen that the organisations placed a high degree of importance for all ORM system factors; however, the extent to which they practiced those factors was different. The statistical testing using SPSS compare mean – a Pairwise *t*-test procedure was performed to determine whether there was any significant difference between the level of importance and the extent of practice.

Results shown in Table 5.6 indicate that there was a significant difference between perceived importance and the extent of practice. Thus, Hypothesis 1 was supported. From the results obtained, it can be concluded that the organisations are aware of the importance of all the ORM system factors; however, they could still be struggling to implement those factors successfully.

Further analysis was carried out to achieve a better understanding of ORM system implementation. In order to measure the effectiveness of an ORM system, an evaluation of its performance needs to be carried out. However, this is a difficult task. Instead of measuring ORM system performance, each ORM system factor will be measured in the way that, if the factor has high mean, we conclude that the factor has a positive impact on an effective ORM system.

The overall mean of each factor was examined by considering the level of importance; the hypothesis will be supported if the overall mean is over 4, on the 5-point Likert scale (Chang 2002). Then, a series of Pairwise comparisons of the highest mean item with others were performed to discover the most related items to the factor using the method suggested by Siegel and Castellan (1956).

Table 5.6 Comparison statistics for practice and importance

Factor	Description	Practice Mean	Importance Mean	*t*-test *p*-value	$t_{critical}$	Results
F1	Leadership	3.53	4.27	0.000	-10.874	Sig.
F2	Planning and strategic alignment	3.88	4.40	0.000	-8.063	Sig.
F3	Implementation	3.56	4.20	0.000	-9.489	Sig.
F4	Monitoring and continuous improvement	3.37	4.22	0.000	-11.302	Sig.
F5	Training and performance appraisal	3.06	4.20	0.000	-14.441	Sig.
F6	Employee involvement and empowerment	3.24	4.18	0.000	-11.615	Sig.
F7	Communication	3.32	4.34	0.000	-12.228	Sig.

$t_{critical}$ value at 0.05 level of significance with 28 degrees of freedom

Hypothesis 2: Leadership has a positive impact on an effective ORM system.

From the results shown in Table 5.7, the mean values of each item under Factor 1 (Leadership) range from 4.18 to 3.98. Item 1.1, 'Top management and leadership are committed to the success of an ORM program', and Item 1.4, 'Top management drives and champions ORM across the organisation', have the highest mean, 4.37. The overall mean was 4.27. Therefore, Hypothesis 2 was supported.

The detail comparison analysis results are presented in Table 5.8. The results show that the two items differed significantly from the highest mean items were 'Regular reviews of organisational performance are conducted to assess progress toward achievement of operational RMS objectives' and 'Appropriate levels of recognition, reward, approval and sanction for risk-related actions are established'.

From the results obtained, top management's leadership and commitment are essential to the success of an ORM program. Moreover, top management should define ORM policy and set ORM objectives that are in line with business objectives. Top management should also act as a key driver in ORM across the organisation and provide adequate resources for ORM activities.

Table 5.7 Mean result of each item in Factor 1

Factor 1: Leadership		Mean	Std. dev.
1.1	Top management and leadership are committed to the success of an ORM program	4.37	0.78
1.2	Clearly defined ORM objectives are tied to the business objectives	4.30	0.68
1.3	The organisation has a defined and documented ORM policy	4.36	0.74
1.4	Top management drives and champions ORM across the organisation	4.37	0.75
1.5	Top management provides adequate resources for ORM activities	4.36	0.75
1.6	Regular reviews of organisational performance are conducted to assess progress toward achievement of operational RMS objectives	4.18	0.85
1.7	Appropriate levels of recognition, reward, approval and sanction for risk-related actions are established	3.98	0.96
Overall mean for Leadership		4.27	

Table 5.8 Pairwise comparison statistics for items of Factor 1

Compare mean	***t*-test** ***p*-value**	**Results**
Item 1.1 vs. Item 1.2	0.277	Not sig.
Item 1.1 vs. Item 1.3	0.841	Not sig.
Item 1.1 vs. Item 1.4	0.909	Not sig.
Item 1.1 vs. Item 1.5	0.906	Not sig.
Item 1.1 vs. Item 1.6	0.004	Sig.
Item 1.1 vs. Item 1.7	0.000	Sig.
Item 1.4 vs. Item 1.5	0.787	Not sig.
Item 1.4 vs. Item 1.6	0.002	Sig.
Item 1.4 vs. Item 1.7	0.000	Sig.

Hypothesis 3: Planing and strategic alignment have a positive impact on an effective ORM system.

From the results shown in Table 5.9, the mean values of each item under Factor 2 (Planning and strategic alignment) range from 4.32 to 4.51. Item 2.3, ‘Operational risks are included in the strategic decision-making process’, has the highest mean, 4.51. The overall mean was 4.40. Therefore, Hypothesis 3 was supported.

Table 5.9 Mean result of each item in Factor 2

Factor 2: Planning and strategic alignment		Mean	Std. dev.
2.1	ORM is viewed as a critical tool in managing our business processes	4.43	0.69
2.2	ORM helps an organisation to minimise losses and maximise business opportunities	4.32	0.85
2.3	Operational risks are included in the strategic decision-making process	4.51	0.60
2.4	ORM plans are consistent with ORM policies and linked to the strategic business plan	4.32	0.63
Overall mean for Planning and strategic alignment		4.40	

The detailed comparison analysis results are presented in Table 5.10. The results show that the items 'ORM helps an organisation to minimise losses and maximise business opportunities' and 'ORM plans are consistent with ORM policies and linked to the strategic business plan' were significantly different from highest mean item. From the results obtained, ORM should be used as a critical tool in managing business processes to minimise losses and maximise business opportunities, and operational risks should be considered when making strategic decision.

Table 5.10 Pairwise comparison statistics for importance items of Factor 2

Compare Mean	*t*-test *p*-value	Results
Item 2.3 vs. Item 2.1	0.220	Not sig.
Item 2.3 vs. Item 2.2	0.005	Sig.
Item 2.3 vs. Item 2.4	0.002	Sig.

Hypothesis 4: Implementation has a positive impact on an effective ORM system.

From the results shown in Table 5.11, the mean values of each item under Factor 3 (Implementation) range from 4.13 to 4.36. Item 3.1, ‘Management of operational risks is carried out in a systematic and repeatable manner’ and Item 3.2, ‘Management of operational risks are integrated and embedded into the organisation's philosophy, practices and business processes’, and Item 3.3, ‘Formal systems and procedures for ORM are implemented throughout the organisation’, have the highest mean, 4.36. The overall mean was 4.30. Therefore, Hypothesis 4 was supported.

Table 5.11 Mean result of each item in Factor 3

Factor 3: Implementation		Mean	Std. dev.
3.1	Management of operational risks is carried out in a systematic and repeatable manner	4.36	0.62
3.2	Management of operational risks are integrated and embedded into the organisation's philosophy, practices and business processes	4.36	0.71
3.3	Formal systems and procedures for ORM are implemented throughout the organisation	4.36	0.68
3.4	Risk management process is used for problem solving, in which problems are recognised, prioritised, and actions taken to resolve them	4.13	0.98
Overall mean for Implementation		4.30	

The detailed comparison analysis results are presented in Table 5.12. The results show that the items ‘Risk management process is used for problem solving, in which problems are recognised, prioritised, and actions taken to resolve them’ was significantly different from the highest mean items. From the results obtained, the implementation of ORM should be carried out in a systematic and repeatable manner throughout the organisation. In addition, it should be integrated and embedded into the organisation’s philosophy, practices and business processes.

Table 5.12 Comparison statistics for importance items of Factor 3

Compare mean	*t*-test *p*-value	Results
Item 3.1 vs. Item 3.2	0.879	Not sig.
Item 3.1 vs. Item 3.3	0.877	Not sig.
Item 3.1 vs. Item 3.4	0.001	Sig.
Item 3.2 vs. Item 3.3	1.000	Not sig.
Item 3.2 vs. Item 3.4	0.003	Sig.
Item 3.3 vs. Item 3.4	0.002	Sig.

Hypothesis 5: Monitoring and continuous improvement have a positive impact on an effective ORM system.

From the results shown in Table 5.13, the mean values of each item under Factor 4 (Implementation) range from 4.20 to 4.24. Item 4.2, 'Operational performance results are used to plan improvement' has the highest mean, 4.24. The overall mean was 4.22. Therefore, Hypothesis 5 was supported.

Table 5.13 Mean result of each item in Factor 4

Factor 4: Monitoring and continuous improvement		Mean	Std. dev.
4.1	Key performance indicators for ORM performance have been identified	4.23	0.79
4.2	Operational performance results are used to plan improvement	4.24	0.81
4.3	Risk management information systems are used to record, track, and monitor risk management activities	4.20	0.84
Overall mean for Monitoring and continuous improvement		4.22	

The detailed comparison analysis results are presented in Table 5.14. The results show that there was no significant difference among all items. From the results obtained, the organisation should identify the key performance indicators for ORM system performance and use the operational performance results to plan the improvement. Moreover, the organisation should set up risk management information systems to record, track and monitor ORM activities.

Table 5.14 Pairwise comparison statistics for importance items of Factor 4

Compare mean	*t*-test *p*-value	Results
Item 4.1 vs. Item 4.2	0.905	Not sig.
Item 4.1 vs. Item 4.3	0.639	Not sig.

Hypothesis 6: Training and performance appraisal have a positive impact on an effective ORM system.

From the results shown in Table 5.15, the mean values of each item under Factor 5 (Training and performance appraisal) range from 4.02 to 4.33. Item 5.2, 'Employees and management receive appropriate training' has the highest mean, 4.33. The overall mean was 4.20. Therefore, Hypothesis 6 was supported.

The detailed comparison analysis results are presented in Table 5.16. The results show that the item 'Operational RMS related performance is part of staff appraisal and performance management system' differed significantly from the highest mean items. From the results obtained, employees and management should have skills in assessing and managing risks, and they should receive appropriate training about risk management.

Table 5.15 Mean result of each item in Factor 5

Factor 5: Training and performance appraisal		Mean	Std. dev.
5.1	Employees and management have appropriate operational risk assessment and management skills	4.24	0.79
5.2	Employees and management receive appropriate training	4.33	0.78
5.3	Operational RMS related performance is part of staff appraisal and performance management system	4.02	0.91
Overall mean for Training and performance appraisal		4.20	

Table 5.16 Pairwise comparison statistics for importance items of Factor 5

Compare mean	***t*-test *p*-value**	Results
Item 5.2 vs. Item 5.1	0.062	Not sig.
Item 5.2 vs. Item 5.3	0.000	Sig.

Hypothesis 7: Employee involvement and empowerment have a positive impact on an effective ORM system.

From the results shown in Table 5.17, the mean values of each item under Factor 6 (Employee involvement and empowerment) range from 4.05 to 4.31. Item 6.3, ‘Employees are empowered and have the authority to deal with operational risks’ has the highest mean, 4.31. The overall mean was 4.18. Therefore, Hypothesis 7 was supported.

The detailed comparison analysis results are presented in Table 5.18. The results show that the items ‘The implementation of the ORM had the involvement of, and consultation with, everyone in the organisation’ and ‘Employees participate in organisation-wide ORM activities’ were differed significantly from the highest mean item. From the results obtained, employees should be involved and work as a team for ORM. Moreover, they should have power and authority to deal with operational risks.

Table 5.17 Mean result of each item in Factor 6

Factor 6: Employee involvement and empowerment		Mean	Std. dev.
6.1	The implementation of the ORM had the involvement of, and consultation with, everyone in the organisation	4.05	0.94
6.2	Employees participate in organisation-wide ORM activities	4.07	0.85
6.3	Employees are empowered and have the authority to deal with operational risks	4.31	0.78
6.4	Teamwork and involvement are normal practices	4.28	0.74
Overall mean for Employee involvement and empowerment		4.18	

Table 5.18 Comparison statistics for importance items of Factor 6

Compare mean	***t*-test *p*-value**	Results
Item 6.3 vs. Item 6.1	0.000	Sig.
Item 6.3 vs. Item 6.2	0.000	Sig.
Item 6.3 vs. Item 6.4	0.574	Not sig.

Hypothesis 8: Communication has a positive impact on an effective ORM system.

From the results shown in Table 5.19, the mean values of each item under Factor 7 (Communication) range from 4.30 to 4.40. Item 7.3, 'Awareness about management of operational risks exists throughout the organisation' has the highest mean, 4.40. The overall mean was 4.34. Therefore, Hypothesis 8 was supported.

Table 5.19 Mean result of each item in Factor 7

Factor 7: Communication		**Mean**	**Std. Dev.**
7.1	ORM policy is understood, implemented and maintained at all levels of the organisation	4.30	0.83
7.2	ORM responsibilities are established and communicated to all levels of organisation	4.32	0.74
7.3	Awareness about management of operational risks exists throughout the organisation	4.40	0.69
Overall mean for Communication		4.34	

The detailed comparison analysis results are presented in Table 5.20. The results show that there was no significant difference among all items. Form the results obtained, ORM policy should be understood, implemented and maintained at all levels of the organisation. In addition, the ORM responsibilities and awareness should be established and communicated throughout the organisation.

Table 5.20 Comparison statistics for importance items of Factor 7

Compare mean	*t*-test *p*-value	Results
Item 7.2 vs. Item 7.1	1.000	Not sig.
Item 7.2 vs. Item 7.3	0.078	Not sig.

Hypothesis 9: There is a significant interrelationship among the seven factors of an ORM system.

The Pearson correlation analysis helped to examine the interrelationship among ORM system factors by calculating their correlation coefficient (r). From the results shown in Table 5.21, the correlation coefficient of all factors range from 0.840 to 0.607, indicating that the interrelationship of all the factors was statistically strong. Therefore, Hypothesis 9 was supported.

From the study findings, the interrelationship of Factor 1 (Leadership) and Factor 3 (Implementation) was the strongest (r = 0.840), followed by that of Factor 1 (Leadership) and Factor 2 (Planing and strategic alignment) (r = 0.811), and then Factor 3 (Implementation) and Factor 7 (Communication) (r = 0.792), respectively. It can be concluded that planning and implementation of effective ORM system would rely significantly on the role of top management leadership and commitment.

Moreover, the implementation of ORM system should be understood and communicated at all levels of the organisation.

Table 5.21 Correlation analysis results of ORM system factors

Factor	1	2	3	4	5	6	7
1	1						
2	0.811*	1					
3	0.840*	0.775*	1				
4	0.752*	0.625*	0.708*	1			
5	0.788*	0.607*	0.756*	0.750*	1		
6	0.776*	0.687*	0.740*	0.681*	0.717*	1	
7	0.784*	0.757*	0.792*	0.628*	0.709*	0.763*	1

* Correlation is significant at the 0.01 level (two-tailed).

5.7 ORM system implementation guideline

Data from 136 Australian organisations were used for analysing and testing the research hypotheses. The following conclusions can be drawn from the discussions and analysis carried out in the previous sections: (a) Implementation of the ORM system was not limited to size or type of organisation. The majority of the surveyed organisations had risk management polices and procedures in place. It appears that there is a trend in increase of awareness of operational risks in organisations. (b) Managing operational risks based on management system standards appears to be a common practice. ISO 9001 (quality management standard) can be seen as the most favourable standard being used as a basis for ORM systems. Other preferred standards included the AS/NZS 4360 (risk management standard), the ISO 14000 (environmental management standard), and/or the AS/NZS 4801 (occupational health and safety management standard). In addition, most of the surveyed organisations employed these standards in integration rather than as stand-alone. (c) Despite the fact that most organisations were aware of the *importance* factors for their ORM systems, they were still struggling with the successful implementation of those factors. ‘Planning and strategic alignment’ factor scored as the highest in the practice and perceived to be the most critical factors among all the other factors. (d) The proposed seven factors in this study – leadership, planning and strategic alignment, implementation, monitoring and continuous improvement, training and performance appraisal, employee involvement and empowerment, and communication – were all found to be critical for successful deployment of an ORM system and there were a strong interrelation among all the factors.

Based on the above findings and discussion with experts on the survey results, the ORM system implementation guideline was developed on the basis of the operations management system (PDCA) model and the theoretical model of ORM system factors which were confirmed by the questionnaire survey data. The schematic presentation of the guideline is displayed in Figure 5.4. As can be seen, there are seven ORM elements and seven processes which are interconnected and interact with each other to determine the effective ORM system. The ORM system implementation guideline is discussed further as follows.

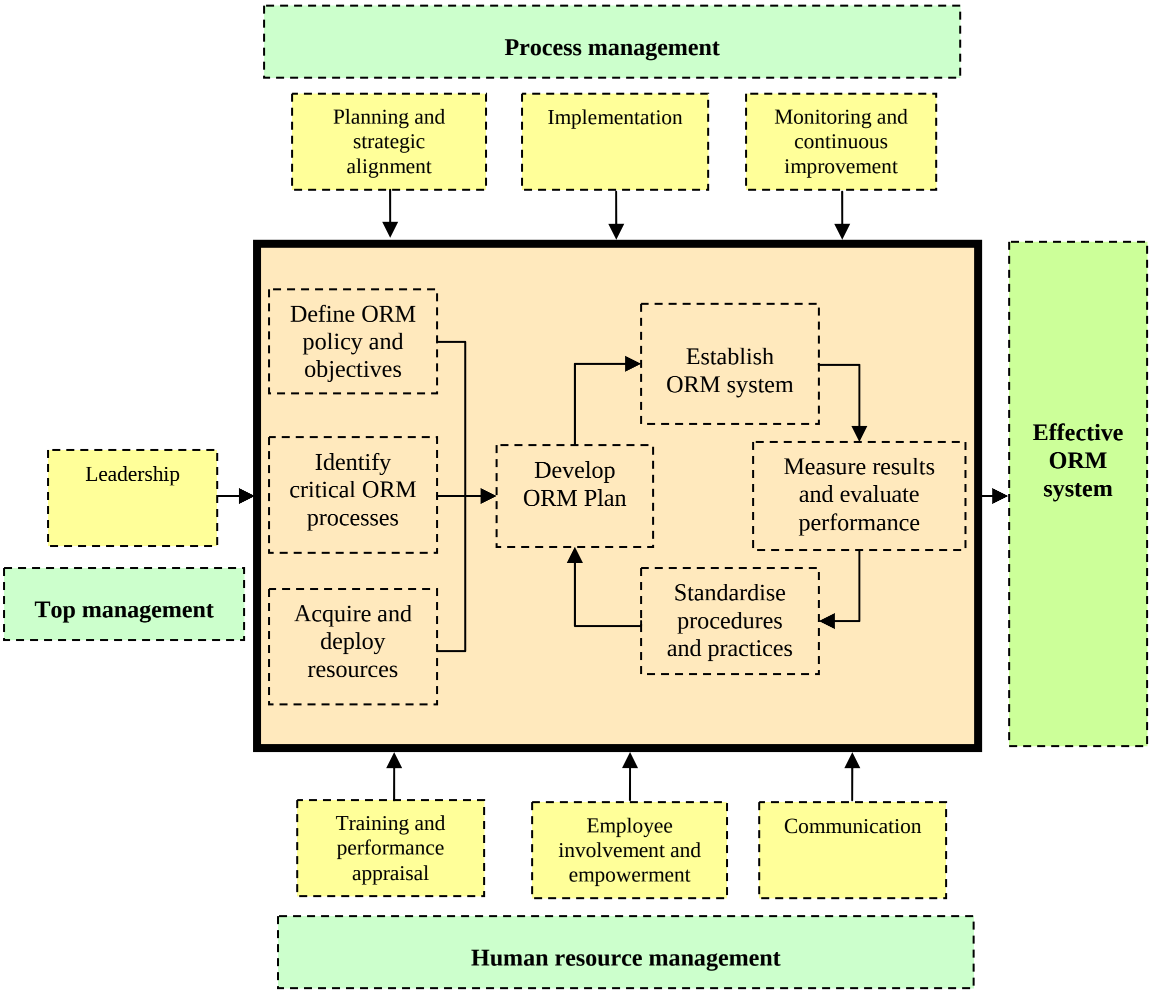

Figure 5.4 ORM system implementation model

5.7.1 Top management

Top management is a crucial factor of any management system implementation. In the case of ORM system, top management is the key driver throughout the whole process of system implementation. Leadership and commitment of top management can bring about ORM initiatives and improvements to the organisation. The main role of top management is to provide leadership and commitment by defining ORM policy and convert the policy into ORM objectives. Top management also needs to ensure that ORM policy and objectives are understood, implemented and maintained at all levels of the organisation. The critical processes and limits of factors that might affect the ORM implementation need to be identified. In particular, top management needs to clearly define the roles and responsibilities, delegate authorities, and assign adequate resources for deployment and maintenance of the ORM system. In addition, review of the ORM system needs to be carried out on a regular basis.

5.7.2 Process management

Every system is made of many processes that interact with each other. These processes have to be managed carefully to ensure an effective system. The planning process itself is one of the critical processes that provide great potential for identifying and controlling other processes (Akpolat 2004). ORM strategies and plans should be developed to be consistent with ORM policy and aligned with strategic plans. ORM should also be used as a critical tool in managing business processes, and operational risks should be considered when making strategic decisions. The ORM system should be established using an integrated approach by incorporating compliance requirements of other management system standards and regulations. It is also important for the organisation to identity key risk performance measures and conduct regular audits. Results of performance reviews and audits need to be used for standardisation of procedures and practices, as well as continuous improvement. Furthermore, ORM information systems should be used to monitor risk management activities, and documents should be controlled for future references.

5.7.3 Human resource management

Employees' involvement in an operations management system is included in most guidelines and practices. However, the involvement of employees requires appropriate knowledge of the various elements of the system. It is necessary to provide proper training and education of ORM to all management and employees. Competence of employees for handling operational risks needs to be regularly evaluated and feedback of their performance should be provided by their superiors. It is also important to reinforce the implementation of risk culture and empower employees to actively manage risks. The ORM responsibilities and awareness should be established and communicated throughout the organisation. Employees should be involved and work as a team for ORM. This usually helps improve employee satisfaction and productivity (Powell 1995; Pun & Hui 2002). Moreover, there should be two-way communication between employees and management regarding ORM matters to ensure the correct decision is made all the time (Sohal & Terziovski 2000).

5.8 Summary

This chapter has presented the results from the survey conducted on ORM system implementation in Australian organisations. Testing of reliability and validity on the research instrument was performed, which concluded that the instrument was reliable and valid to measure what it intended to measure. The analysis results revealed that there was a significant difference between the means of perceived importance and levels of practice, indicating that the organisations have not performed the activities they perceived to be important for ORM system. Another major finding was the results of hypotheses testing that confirmed the proposed seven factors – leadership, planing and strategic alignment, implementation, monitoring and continuous improvement, training and performance appraisal, employee involvement and empowerment, and communication – are interrelated and critical to the success of ORM system implementation. Based on the findings, the ORM system implementation guideline was developed. This guideline is generic in nature because it does not prescribe a series of steps to undertake or follow, but rather an overview in working towards building an effective ORM system. Refinements to the framework could be made in the future, in particular on the case studies. It was not possible in this research to have case studies due to resource limitations and constraints.

Nevertheless, it is believed that the guideline provided will be of great benefit to many organisations which are still struggling to implement an effective ORM system.

Chapter 6 Conclusions

6.1 Introduction

This chapter provides the summary of this thesis, research conclusions obtained from this study and a brief research evaluation. Section 6.2 presents a brief summary of this study. Section 6.3 provides conclusions obtained from conducting this research Section 6.4 focuses on a brief research evaluation including research limitations and future research perspectives. Finally, Section 6.5 presents contributions of this research.

6.2 Brief summary

In the field of operations management, a large number of research studies have been conducted dealing with the reduction of process variability, increasing flexibility or implementing controls in operations. Managing risk in operations has focused more on reducing the risks of producing non-conforming products or inadequate services (quality risks). In fact, the concept of ORM was not clearly defined. Concerning the effects and the factors of ORM system implementation, a number of researchers concluded that implementation of one or more operations management systems has proactively reduced losses or risks in operations; however, there is a limited number of empirical studies in this area.

After the literature related to ORM system implementation in Australian organisations was studied, it became evident that no empirical research dealing with the success factors of ORM system implementation performance had been systematically conducted. In addition, no research has been conducted for developing an ORM implementation model that can be used by Australian organisations to effectively manage their operational risks. The lack of specific guidelines to assist organisations' ORM system implementation has led to a number of unsuccessful ORM system implementations in Australia. Therefore, the major objectives of this study were:

- to obtain the success factors of ORM system implementation in Australian organisations
- to obtain an ORM system implementation model for Australian organisations.

To achieve the two research objectives, three research questions were proposed as follows, namely:

- What is ORM system?
- What are the current ORM system practices in Australian organisations?
- What are the critical success factors of an effective ORM system implementation?

As the first step of this study, an extensive review of operations management literature and various standards and frameworks including AS/NZS 4360 (risk management standard), COSO ERM (enterprise-wide risk management framework), ISO 9001 (quality management system standard), ISO 14000 (environmental management system standard) and AS/NZS 4801 (occupational health and safety management system standard) was conducted. Based on this literature review, seven factors were considered important for ORM system implementation: leadership, planning and strategic alignment, implementation, monitoring and continuous improvement, training and performance appraisal, employee involvement and empowerment, and communication. Thus, a model of ORM system implementation was formulated on the basis of the existing research results. This model consists of nine hypotheses.

To achieve the research objectives and answer the research questions, web-based questionnaire survey was chosen as an instrument for this research. The URL link of the web-based questionnaire was emailed to 450 organisations Australia-wide. Only organisations certified to one or more management system standards were selected to receive questionnaires; these 450 organisations were randomly selected from the JAS-ANZ database in conjunction with the Kompass database. Finally, 136 questionnaires were returned, with a response rate of approximately 32%.

The measurement instrument was evaluated for reliability and validity using the data from 136 respondents. Reliability analysis (internal consistency) and validity analysis (content, construct and criterion-related analysis) were used for instrument evaluation.

Finally, it was concluded that the instrument for measuring ORM system implementation is reliable and valid.

The statistical analysis package SPSS Version 15 was used to conduct the analysis of the collected data from 136 respondents. Preliminary data analysis was performed using descriptive statistics (e.g. mean, standard deviation and frequency distribution) before conducting tests of hypotheses. Parametric tests including *t*-test and the Pearson correlation were employed for testing the research hypotheses.

The analysis results revealed that there was a significant difference that organisations have not performed the activities they perceived to be important for ORM systems. Another major finding was the results of hypotheses testing that confirmed (all) the proposed seven factors – leadership, planing and strategic alignment, implementation, monitoring and continuous improvement, training and performance appraisal, employee involvement and empowerment, and communication – are interrelated and critical to the success of ORM system implementation. Findings from the survey and the inputs from experts were used for the development of the ORM system implementation model. As part of this process some useful guidelines were developed as well. It should be noted that there is no single or best way of implementing this ORM system implementation model. Organisations differ in structure, resources, culture, goals, technologies, processes and operating environments. Therefore, they should combine their uniqueness with the model and develop their own ways to excellence. Although this model was initially developed for Australian organisations,

organisations in other countries can also use it as reference, since the existing knowledge of operations management systems was used extensively in developing this model.

Finally, it is necessary to review the study of the three research questions. The first question, ‘What is ORM system?’ was answered on the basis of the extensive literature review. The defined ORM system concept was used throughout this study, which laid a solid foundation for conducting this research. The second question ‘What are the current ORM system practices in Australian organisations?’ and third question ‘What are the critical success factors of an effective ORM system implementation?’, were answered using the data from 136 respondents of Australian organisations. The status of ORM in Australia and the perception regarding the critical success factors for managing operational risks in Australian organisations were identified. In summary, the three research questions were answered and the two research objectives achieved through conducting this study.

6.3 Summary

The following conclusions have been obtained from this research. First, the instrument in this study is reliable and valid. It can be used by other researchers in future studies in the ORM system implementation area. Second, several conclusions have been obtained from survey analysis, which are listed as follows: (1) ORM system implementation is not limited to the size of the organisation. It is implemented by large organisations as well as SMEs; (2) ISO 9001 (quality management standard) was the most favourable standard used for ORM system implementation. AS/NZS 4360 (risk management standard), ISO 14000 (environmental management standard), and AS/NZS 4801 (occupational health and safety management standard) were the alternatives for many organisations, while COSO and other standards seems relatively negligible; (3) A large number of organisations used management system standards as an integrated approach rather than stand-alone. A majority of organisations were moving toward the amalgamation of all the management systems into a single integrated management system; (4) Organisations were aware of the importance of all the ORM system factors; however, they could be still struggling to implement those factors successfully. Planning and strategic alignment factors are well practised and perceived to be the most critical factors among all the other factors; (5) All proposed ORM system elements including Leadership, Planning and strategic alignment, Implementation, Monitoring and continuous improvement, Training and performance appraisal, Employee involvement and empowerment, and Communication have a positive impact on the ORM system. Consequently, all these factors are considered to be critical to effective ORM system implementation; (6) There is a trend towards strong positive correlation among all critical success factors.

6.4 Limitation and future research perspectives

The research has been completed. It is necessary to evaluate this study in the context of its limitations. The limitations of this study are discussed as follows:

- This research is exploratory in nature. Thus, it identifies the ‘what’ about ORM system but not ‘why’.
- Data used in this study came from only 136 respondents of Australian organisations certified to one or more management system standards. This may limit the representativeness of the finding and its generalisation.

The direction of future research is recommended as follows:

- Replication of this study would be helpful in re-examining the validity of its findings. Further empirical studies using larger sample sizes, greater geographical diversity and firm type diversity would be helpful in validating specific parts of the theoretical models proposed in this study.
- This study would be investigated in different countries to test whether they go in the same or different directions.
- A set of longitudinal studies would be very valuable in studying the time dimension of ORM system implementation.

- Structured interviews would be conducted in different types of Australian organisations in order to continuously improve the ORM system implementation model.
- An in-depth case study would be conducted in an Australian organisation to gain more insight into using this ORM system implementation model in practice.

6.5 Research contributions

The major contributions in this research are shown as follows:

- A reliable and valid research instrument has been developed.
- Seven factors that are critical to the success of ORM system implementation in Australian organisation are identified.
- A model and guidelines for ORM system implementation have been proposed.

With the above contributions, this research establishes a foundation for ORM researchers to continue in their future research studies on ORM system implementation. In addition, the results of this study can be beneficial to practitioners to understand the core characteristics of the ORM system and appropriate roles in the organisation they should play to achieve ORM excellence.

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Appendix 1 Final version of questionnaire survey

UTS: ENGINEERING

UTS

University of Technology, Sydney

SURVEY

Operational Risk Management (ORM) System

Operational Risk Management (ORM) systems are used for the systemic management of risks in any operation, that may include:

- Quality, safety, and environmental risks
- Risks associated with the management of facilities and infrastructures
- Risks of failure of IT systems and services
- Risks associated with corporate and marketing compliance

This survey is part of a PhD research project under the supervision of Dr Hasan Akpolat and intended to obtain information on how Australian organisations manage operational risks.

The following questionnaire should take about 5 minutes to complete and can be answered by any person who is familiar with the operational management systems in your organisation.

Section 1: General organisation information

1. What department / division do you belong to? (Please select one)

- ☐ Human Resources
- ☐ Operations
- ☐ Sales & Marketing
- ☐ Other ________

2. What is your industry? (Please select one)

- ☐ Mining
- ☐ Electricity, Gas and Water supply
- ☐ Wholesale Trade
- ☐ Hospitality
- ☐ Media and Communications
- ☐ Health and Community services
- ☐ Manufacturing
- ☐ Construction
- ☐ Retail Trade
- ☐ Transport and Storage
- ☐ Education
- ☐ Other ________

3. What is the size of your organisation? (Please select one)

- under 20 employees
- 20 -199 employees
- 200 - 499 employees
- 500 - 2499 employees
- over 2500

4. Does your organisation have formal risk management policies or procedures?

- Yes
- No

5. Does your organisation have a single or multiple ORM systems, or none at all? (Please select one)

- Single
- Multiple
- None

6. Does the person(s) in charge of your ORM system report to top management?

- Yes
- No

7. Does your organisation use any Australian or International management system standards as basis for your ORM?

- Yes
- No

8. If you selected "Yes" in Q7, what management system standards are being used? (Please select more than one if necessary.)

- AS/NZS 4360 Risk management system standard
- COSO Enterprise-wide risk management framework
- ISO 9001:2001 Quality management system standard
- ISO 14001 Environmental management system standard
- AS/NZS 4801 Occupational health and safety management system standard
- Other(s) ________

9. To what extent is the ORM in your organisation integrated with other management systems?

Not at all ○ ○ ○ ○ ○ Fully integrated

Section 2: Success factors for ORM systems

This section presents a number of statements about the way an ORM system might be used in an organisation. For each statement, you are asked to give two (2) ratings.

The first gives the extent to which you agree that the statement applies in your own organisation. You will give these ratings in the column labelled "IN MY ORGANISATION".

Strongly Disagree	1	2	3	4	5	Strongly Agree

The second gives the extent to which you agree that the statement reflects what is important for the successful of ORM system. You are to give these ratings in the column with the heading "IMPORTANCE".

Not Important At All	1	2	3	4	5	Vital

Top management, leadership, strategy

FACTORS	IN MY ORGANISATION 1:Strongly Disagree, 5: Stongly Agree					IMPORTANCE 1:Not Important At All, 5: Vital				
	1	2	3	4	5	1	2	3	4	5
10. ORM is viewed as a critical tool in managing our business processes	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
11. ORM helps an organisation to minimise losses and business opportunities	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
12. Top management and leadership are committed to the success of an ORM program	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐
13. Operational risks are included in the strategic decision-making process	☐	☐	☐	☐	☐	☐	☐	☐	☐	☐

14. Clearly defined ORM objectives are tied to the business objectives										
15. The organisation has a defined and documented ORM policy										
16. ORM policy is understood, implemented and maintained at all levels of the organisation										
17. Top management drives and champions ORM across the organisation										
18. Top management provides adequate resources for ORM activities										

Implementation, system, measurement

FACTORS	IN MY ORGANISATION 1:Strongly Disagree, 5: Strongly Agree					IMPORTANCE 1:Not Important At All, 5: Vital				
	1	2	3	4	5	1	2	3	4	5
19. Management of operational risks is carried out in a systematic and repeatable manner										
20. Management of operational risks are integrated and embedded into the organisation's philosophy, practices and business processes										

31. Risk management process is used for problem solving, in which problems are recognised, prioritised, and actions taken to resolve them										
32. Key performance indicators for ORM system performance have been identified										
33. Regular reviews of organisational performance are conducted to assess progress toward achievement of ORM objectives										
34. Operational performance results are used to plan improvement										
35. Risk management information systems are used to record, track, and monitor risk management activities										
36. Appropriate levels of recognition, reward, approval and sanction for risk-related actions are established										
37. ORM system-related performance is part of staff appraisal and performance management system										

Submit the survey

Appendix 2 Letter of approval from UTS Human Research Ethics Committee

UNIVERSITY OF TECHNOLOGY SYDNEY

Research and Innovation Office
City Campus
Building 1, Level 7,
Room 7.19, Broadway
PO Box 123 Broadway
NSW 2007 Australia
T: +61 2 9514 9681
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www.uts.edu.au

16 May 2007

Dr Hassan Akpolat
CB02.05.26
Faculty of Engineering
UNIVERSITY OF TECHNOLOGY, SYDNEY

Dear Hassan,

UTS HREC REF NO 2007-58 – AKPOLAT, Dr Hassan (for PITINANONDHA, Ms Thitima PhD student) - "Managing Operational Risks In Australian Organisations"

Thank you for your response to my email dated 18 April 2007. Your response satisfactorily addresses the concerns and questions raised by the Committee, and I am pleased to inform you that ethics clearance is now granted.

Your clearance number is UTS HREC REF NO. 2007-58A

Please note that the ethical conduct of research is an on-going process. The *National Statement on Ethical Conduct in Research Involving Humans* requires us to obtain a report about the progress of the research, and in particular about any changes to the research which may have ethical implications. This report form must be completed at least annually, and at the end of the project (if it takes more than a year). The Ethics Secretariat will contact you when it is time to complete your first report.

I also refer you to the AVCC guidelines relating to the storage of data, which require that data be kept for a minimum of 5 years after publication of research. However, in NSW, longer retention requirements are required for research on human subjects with potential long-term effects, research with long-term environmental effects, or research considered of national or international significance, importance, or controversy. If the data from this research project falls into one of these categories, contact University Records for advice on long-term retention.

If you have any queries about your ethics clearance, or require any amendments to your research in the future, please do not hesitate to contact the Ethics Secretariat at the Research and Innovation Office, on 02 9514 9615.

Yours sincerely,

Production Note:
Signature removed prior to publication.

Professor Jane Stein-Parbury
Chairperson
UTS Human Research Ethics Committee

THINK.CHANGE.DO

Appendix 3: Example of survey email

Dear Madam/Sir,

This survey is part of my PhD research project under the supervision of Dr Hasan Akpolat at University of Technology Sydney and intended to obtain information on how organisations manage operational risks Australia and New Zealand.

Operational Risk Management (ORM) systems are used for the systemic management of risks that may include:

• Quality, safety, and environmental risks
• Risks associated with the management of facilities and infrastructures
• Risks of failure of IT systems and services
• Risks associated with corporate and marketing compliance

The following questionnaire should only take about 5 minutes to complete:
http://services.eng.uts.edu.au/~hasan/orms_survey.html

Please also forward the questionnaire to the person(s) who is/are familiar with management systems in your organisation.
It would be much appreciated if the survey is completed within the next few days.

If you would like a copy of the results of this study, please send the blank email to Thitima.Pitinanondha@eng.uts.edu.au.

Thank you very much for your participation in this survey.

Kindest regards,

Thitima Pitinanondha
PhD Candidate
Management, Policy and Practice Group
UTS, Faculty of Engineering
City Campus, Room CB.02.303

Mail Address:
University of Technology Sydney
PO Box 123, Broadway NSW 2007, Australia
Phone: 61-2-9514 2647
Fax: 61-2-9514 2633
Email: Thitima.Pitinanondha@eng.uts.edu.au

Appendix 4 Questionnaire coding sheet

Question	Variable Number	Code Description	Variable Name
	1	Identification Number	ID
1	2	Department 1 = HR 2 = Operations 3 = Sales & Marketing 4 = Others 9 = Missing	Department
2	3	Operation type 1 = Mining 2 = Electricity, Gas and Water supply 3 = Wholesale Trade 4 = Hospitality 5 = Media and Communications 6 = Health and Community services 7 = Manufacturing 8 = Construction 9 = Retail Trade 10 = Transport and Storage 11 = Education 99 = Missing	Operation
3	4	Organisation size 1 = under 20 employees 2 = 20 -199 employees 3 = 200 - 499 employees 4 = 500 - 2499 employees 5 = over 2500 9 = Missing	Size
4	5	Risk Policy 1 = Yes 2 = No 9 = Missing	Policy
5	6	ORMS system 1 = Single 2 = Multiple 3 = None 9 = Missing	System
6	7	Risk Manager 1 = Yes 2 = No 9 = Missing	Manager
7	8	Use standard as a guideline 1 = Yes 2 = No 9 = Missing	Guideline
8	9	AS/NZS 4360 1 = Tick 9 = No tick	AS4360

Question	Variable Number	Code Description	Variable Name
8	10	COSO 1 = Tick 9 = No tick	COSO
8	11	ISO 9001 1 = Tick 9 = No tick	ISO9001
8	12	ISO 14000 1 = Tick 9 = No tick	ISO14000
8	13	AS/NZS 4801 1 = Tick 9 = No tick	AS4801
8	14	Other standards 1 = Tick 9 = No tick	Others
9	15	System Integration 1 = Not at all 2 = Low 3 = Medium 4 = High 5 = Full integrated 9 = Missing	Integration
10	16	10 Practice 1 = Strongly disagree 2 = disagree 3 = Neutral 4 = Agree 5 = Strongly agree 9 = Missing	Planning1p
10	17	10 Importance 1 = Not important at all 2 = Not important 3 = Neutral important 4 = Important 5 = Vital 9 = Missing	Planning1i
11	18	11 Practice 1 = Strongly disagree 2 = disagree 3 = Neutral 4 = Agree 5 = Strongly agree 9 = Missing	Planning2p
11	19	11 Importance 1 = Not important at all 2 = Not important 3 = Neutral important 4 = Important 5 = Vital 9 = Missing	Planning2i

Question	Variable Number	Code Description	Variable Name
12	20	12 Practice 1 = Strongly disagree 2 = disagree 3 = Neutral 4 = Agree 5 = Strongly agree 9 = Missing	Leadership1p
12	21	12 Importance 1 = Not important at all 2 = Not important 3 = Neutral important 4 = Important 5 = Vital 9 = Missing	Leadership1i
13	22	13 Practice 1 = Strongly disagree 2 = disagree 3 = Neutral 4 = Agree 5 = Strongly agree 9 = Missing	Planning3p
13	23	13 Importance 1 = Not important at all 2 = Not important 3 = Neutral important 4 = Important 5 = Vital 9 = Missing	Planning3i
14	24	14 Practice 1 = Strongly disagree 2 = disagree 3 = Neutral 4 = Agree 5 = Strongly agree 9 = Missing	Leadership2p
14	25	14 Importance 1 = Not important at all 2 = Not important 3 = Neutral important 4 = Important 5 = Vital 9 = Missing	Leadership2i
15	26	15 Practice 1 = Strongly disagree 2 = disagree 3 = Neutral 4 = Agree 5 = Strongly agree 9 = Missing	Leadership3p

Question	Variable Number	Code Description	Variable Name
15	27	15 Importance 1 = Not important at all 2 = Not important 3 = Neutral important 4 = Important 5 = Vital 9 = Missing	Leadership3i
16	28	16 Practice 1 = Strongly disagree 2 = disagree 3 = Neutral 4 = Agree 5 = Strongly agree 9 = Missing	Communication1p
16	29	16 Importance 1 = Not important at all 2 = Not important 3 = Neutral important 4 = Important 5 = Vital 9 = Missing	Communication1i
17	30	17 Practice 1 = Strongly disagree 2 = disagree 3 = Neutral 4 = Agree 5 = Strongly agree 9 = Missing	Leadership4p
17	31	17 Importance 1 = Not important at all 2 = Not important 3 = Neutral important 4 = Important 5 = Vital 9 = Missing	Leadership4i
18	32	18 Practice 1 = Strongly disagree 2 = disagree 3 = Neutral 4 = Agree 5 = Strongly agree 9 = Missing	Leadership5p
18	33	18 Importance 1 = Not important at all 2 = Not important 3 = Neutral important 4 = Important 5 = Vital 9 = Missing	Leadership5i

Question	Variable Number	Code Description	Variable Name
19	34	19 Practice 1 = Strongly disagree 2 = disagree 3 = Neutral 4 = Agree 5 = Strongly agree 9 = Missing	Implementation1p
19	35	19 Importance 1 = Not important at all 2 = Not important 3 = Neutral important 4 = Important 5 = Vital 9 = Missing	Implementation1i
20	36	20 Practice 1 = Strongly disagree 2 = disagree 3 = Neutral 4 = Agree 5 = Strongly agree 9 = Missing	Implementation2p
20	37	20 Importance 1 = Not important at all 2 = Not important 3 = Neutral important 4 = Important 5 = Vital 9 = Missing	Implementation2i
21	38	21 Practice 1 = Strongly disagree 2 = disagree 3 = Neutral 4 = Agree 5 = Strongly agree 9 = Missing	Planning4p
21	39	21 Importance 1 = Not important at all 2 = Not important 3 = Neutral important 4 = Important 5 = Vital 9 = Missing	Planning4i
22	40	22 Practice 1 = Strongly disagree 2 = disagree 3 = Neutral 4 = Agree 5 = Strongly agree 9 = Missing	Communication2p

Question	Variable Number	Code Description	Variable Name
22	41	22 Importance 1 = Not important at all 2 = Not important 3 = Neutral important 4 = Important 5 = Vital 9 = Missing	Communication2i
23	42	23 Practice 1 = Strongly disagree 2 = disagree 3 = Neutral 4 = Agree 5 = Strongly agree 9 = Missing	Implementation3p
23	43	23 Importance 1 = Not important at all 2 = Not important 3 = Neutral important 4 = Important 5 = Vital 9 = Missing	Implementation3i
24	44	24 Practice 1 = Strongly disagree 2 = disagree 3 = Neutral 4 = Agree 5 = Strongly agree 9 = Missing	Communication3p
24	45	24 Importance 1 = Not important at all 2 = Not important 3 = Neutral important 4 = Important 5 = Vital 9 = Missing	Communication3i
25	46	25 Practice 1 = Strongly disagree 2 = disagree 3 = Neutral 4 = Agree 5 = Strongly agree 9 = Missing	Employee1p
25	47	25 Importance 1 = Not important at all 2 = Not important 3 = Neutral important 4 = Important 5 = Vital 9 = Missing	Employee1i

Question	Variable Number	Code Description	Variable Name
26	48	26 Practice 1 = Strongly disagree 2 = disagree 3 = Neutral 4 = Agree 5 = Strongly agree 9 = Missing	Employee2p
26	49	26 Importance 1 = Not important at all 2 = Not important 3 = Neutral important 4 = Important 5 = Vital 9 = Missing	Employee2i
27	50	27 Practice 1 = Strongly disagree 2 = disagree 3 = Neutral 4 = Agree 5 = Strongly agree 9 = Missing	Employee3p
27	51	27 Importance 1 = Not important at all 2 = Not important 3 = Neutral important 4 = Important 5 = Vital 9 = Missing	Employee3i
28	52	28 Practice 1 = Strongly disagree 2 = disagree 3 = Neutral 4 = Agree 5 = Strongly agree 9 = Missing	Employee4p
28	53	28 Importance 1 = Not important at all 2 = Not important 3 = Neutral important 4 = Important 5 = Vital 9 = Missing	Employee4i
29	54	29 Practice 1 = Strongly disagree 2 = disagree 3 = Neutral 4 = Agree 5 = Strongly agree 9 = Missing	Training1p

Question	Variable Number	Code Description	Variable Name
29	55	29 Importance 1 = Not important at all 2 = Not important 3 = Neutral important 4 = Important 5 = Vital 9 = Missing	Training1i
30	56	30 Practice 1 = Strongly disagree 2 = disagree 3 = Neutral 4 = Agree 5 = Strongly agree 9 = Missing	Training2p
30	57	30 Importance 1 = Not important at all 2 = Not important 3 = Neutral important 4 = Important 5 = Vital 9 = Missing	Training2i
31	58	31 Practice 1 = Strongly disagree 2 = disagree 3 = Neutral 4 = Agree 5 = Strongly agree 9 = Missing	Implementation4p
31	59	31 Importance 1 = Not important at all 2 = Not important 3 = Neutral important 4 = Important 5 = Vital 9 = Missing	Implementation4i
32	60	32 Practice 1 = Strongly disagree 2 = disagree 3 = Neutral 4 = Agree 5 = Strongly agree 9 = Missing	Monitoring1p
32	61	32 Importance 1 = Not important at all 2 = Not important 3 = Neutral important 4 = Important 5 = Vital 9 = Missing	Monitoring1i

Question	Variable Number	Code Description	Variable Name
33	62	33 Practice 1 = Strongly disagree 2 = disagree 3 = Neutral 4 = Agree 5 = Strongly agree 9 = Missing	Leadership6p
33	63	33 Importance 1 = Not important at all 2 = Not important 3 = Neutral important 4 = Important 5 = Vital 9 = Missing	Leadership6i
34	64	34 Practice 1 = Strongly disagree 2 = disagree 3 = Neutral 4 = Agree 5 = Strongly agree 9 = Missing	Monitoring2p
34	65	34 Importance 1 = Not important at all 2 = Not important 3 = Neutral important 4 = Important 5 = Vital 9 = Missing	Monitoring2i
35	66	35 Practice 1 = Strongly disagree 2 = disagree 3 = Neutral 4 = Agree 5 = Strongly agree 9 = Missing	Monitoring3p
35	67	35 Importance 1 = Not important at all 2 = Not important 3 = Neutral important 4 = Important 5 = Vital 9 = Missing	Monitoring3i
36	68	36 Practice 1 = Strongly disagree 2 = disagree 3 = Neutral 4 = Agree 5 = Strongly agree 9 = Missing	Leadership7p

Question	Variable Number	Code Description	Variable Name
36	69	36 Importance 1 = Not important at all 2 = Not important 3 = Neutral important 4 = Important 5 = Vital 9 = Missing	Leadership7i
37	70	37 Practice 1 = Strongly disagree 2 = disagree 3 = Neutral 4 = Agree 5 = Strongly agree 9 = Missing	Training3p
37	71	37 Importance 1 = Not important at all 2 = Not important 3 = Neutral important 4 = Important 5 = Vital 9 = Missing	Training3i

Appendix 5 Missing data analysis

Variable	Mean	Std. dev.	Min.	Max.	Max poss. N	Valid N	Missing data	% Missing data
Q1	2.82	1.027	1	4	136	136	0	0
Q2	9.43	2.378	2	12	136	136	0	0
Q3	4.10	1.276	1	5	136	136	0	0
Q4	1.05	.222	1	2	136	136	0	0
Q5	1.72	.526	1	3	136	136	0	0
Q6	1.10	.296	1	2	136	135	1	0.74
Q7	1.08	.274	1	2	136	136	0	0
Q9	3.82	1.137	1	5	136	136	0	0
Q10p	4.04	.972	1	5	136	134	2	1.47
Q10i	4.43	.688	2	5	136	134	2	1.47
Q11p	4.13	.856	1	5	136	133	3	2.21
Q11i	4.32	.972	1	5	136	134	2	1.47
Q12p	3.90	.987	1	5	136	135	1	0.74
Q12i	4.37	.780	2	5	136	135	1	0.74
Q13p	3.86	1.038	1	5	136	135	1	0.74
Q13i	4.51	.598	3	5	136	134	2	1.47
Q14p	3.66	1.098	1	5	136	134	2	1.47
Q14i	4.30	.683	2	5	136	134	2	1.47
Q15p	4.10	1.046	1	5	136	135	1	0.74
Q15i	4.36	.740	1	5	136	134	2	1.47
Q16p	3.16	1.139	1	5	136	135	1	0.74
Q16i	4.30	.829	1	5	136	135	1	0.74
Q17p	3.51	1.112	1	5	136	135	1	0.74
Q17i	4.37	.753	2	5	136	134	2	1.47
Q18p	3.33	1.125	1	5	136	135	1	0.74
Q18i	4.36	.750	2	5	136	134	2	1.47
Q19p	3.63	1.025	1	5	136	136	0	0.00
Q19i	4.36	.618	2	5	136	135	1	0.74
Q20p	3.73	.976	1	5	136	128	8	5.88
Q20i	4.36	.706	2	5	136	136	0	0.00
Q21p	3.50	1.036	1	5	136	135	1	0.74
Q21i	4.32	.631	2	5	136	136	0	0.00
Q22p	3.25	1.063	1	5	136	135	1	0.74
Q22i	4.32	.740	1	5	136	135	1	0.74
Q23p	3.69	1.058	1	5	136	134	2	1.47
Q23i	4.36	.680	2	5	136	132	4	2.94
Q24p	3.55	1.039	1	5	136	136	0	0.00
Q24i	4.40	.692	1	5	136	136	0	0.00
Q25p	2.86	1.218	1	5	136	136	0	0.00
Q25i	4.05	.937	1	5	136	136	0	0.00
Q26p	3.10	1.194	1	5	136	136	0	0.00
Q26i	4.07	.849	1	5	136	136	0	0.00
Q27p	3.50	1.078	1	5	136	135	1	0.74
Q27i	4.31	.784	1	5	136	136	0	0.00

Variable	Mean	Std. dev.	Min.	Max.	Max poss. N	Valid N	Missing data	% Missing data
Q28p	3.51	1.040	1	5	136	136	0	0.00
Q28i	4.28	.740	2	5	136	135	1	0.74
Q29p	3.04	.988	1	5	136	136	0	0.00
Q29i	4.24	.791	1	5	136	136	0	0.00
Q30p	3.06	1.107	1	5	136	136	0	0.00
Q30i	4.33	.781	1	5	136	135	1	0.74
Q31p	3.21	1.078	1	5	136	136	0	0.00
Q31i	4.13	.985	1	5	136	136	0	0.00
Q32p	3.40	1.156	1	5	136	136	0	0.00
Q32i	4.23	.788	1	5	136	136	0	0.00
Q33p	3.35	1.092	1	5	136	136	0	0.00
Q33i	4.18	.845	1	5	136	136	0	0.00
Q34p	3.39	1.058	1	5	136	135	1	0.74
Q34i	4.24	.815	1	5	136	135	1	0.74
Q35p	3.33	1.164	1	5	136	135	1	0.74
Q35i	4.20	.836	2	5	136	135	1	0.74
Q36p	2.85	1.115	1	5	136	136	0	0.00
Q36i	3.98	.961	1	5	136	134	2	1.47
Q37p	3.07	1.196	1	5	136	136	0	0.00
Q37i	4.02	.913	1	5	136	134	2	1.47

Appendix 6: Factor analysis

Factor 1: Leadership

Communalities

	Initial	Extraction
Leadership 1	1.000	.658
Leadership 2	1.000	.564
Leadership 3	1.000	.405
Leadership 4	1.000	.647
Leadership 5	1.000	.603
Leadership 6	1.000	.489
Leadership 7	1.000	.574

Extraction method: Principal component analysis.

Total variance explained

Component	Initial eigenvalues			Extraction sums of squared loadings		
	Total	% of variance	Cumulative %	Total	% of variance	Cumulative %
1	3.941	56.293	56.293	3.941	56.293	56.293
2	.749	10.697	66.990			
3	.669	9.562	76.553			
4	.554	7.910	84.462			
5	.457	6.530	90.993			
6	.316	4.516	95.509			
7	.314	4.491	100.000			

Extraction method: Principal component analysis.

Component matrix(a)

	Component
	1
Leadership 1	.811
Leadership 2	.751
Leadership 3	.636
Leadership 4	.804
Leadership 5	.777
Leadership 6	.699
Leadership 7	.758

Extraction method: Principal component analysis.
a 1 components extracted.

Factor 2: Planning and strategic alignment

Communalities

	Initial	Extraction
Planning 1	1.000	.700
Planning 2	1.000	.553
Planning 3	1.000	.701
Planning 4	1.000	.645

Extraction method: Principal component analysis.

Total variance explained

Component	Initial eigenvalues			Extraction sums of squared loadings		
	Total	% of variance	Cumulative %	Total	% of variance	Cumulative %
1	2.599	64.975	64.975	2.599	64.975	64.975
2	.595	14.880	79.855			
3	.494	12.350	92.205			
4	.312	7.795	100.000			

Extraction method: Principal component analysis.

Component matrix(a)

	Component
	1
Planning 1	.837
Planning 2	.744
Planning 3	.837
Planning 4	.803

Extraction method: Principal component analysis.
a 1 components extracted.

Factor 3: Implementation

Communalities

	Initial	Extraction
Implementation 1	1.000	.761
Implementation 2	1.000	.679
Implementation 3	1.000	.743
Implementation 4	1.000	.638

Extraction method: Principal component analysis.

Total variance explained

Component	Initial eigenvalues			Extraction sums of squared loadings		
	Total	% of variance	Cumulative %	Total	% of variance	Cumulative %
1	2.821	70.518	70.518	2.821	70.518	70.518
2	.482	12.060	82.578			
3	.392	9.801	92.379			
4	.305	7.621	100.000			

Extraction method: Principal component analysis.

Component matrix(a)

	Component
	1
Implementation 1	.873
Implementation 2	.824
Implementation 3	.862
Implementation 4	.799

Extraction method: Principal component analysis.
a 1 components extracted.

Factor 4: Monitoring and continuous improvement

Communalities

	Initial	Extraction
Monitoring 1	1.000	.647
Monitoring 2	1.000	.610
Monitoring 3	1.000	.708

Extraction method: Principal component analysis.

Total variance explained

Component	Initial eigenvalues			Extraction sums of squared loadings		
	Total	% of variance	Cumulative %	Total	% of variance	Cumulative %
1	1.965	65.511	65.511	1.965	65.511	65.511
2	.582	19.384	84.895			
3	.453	15.105	100.000			

Extraction method: Principal component analysis.

Component matrix(a)

	Component
	1
Monitoring 1	.804
Monitoring 2	.781
Monitoring 3	.841

Extraction method: Principal component analysis.
a 1 components extracted.

Factor 5: Training and performance appraisal

Communalities

	Initial	Extraction
Training 1	1.000	.727
Training 2	1.000	.730
Training 3	1.000	.542

Extraction method: Principal component analysis.

Total variance explained

Component	Initial eigenvalues			Extraction sums of squared loadings		
	Total	% of variance	Cumulative %	Total	% of variance	Cumulative %
1	2.000	66.650	66.650	2.000	66.650	66.650
2	.628	20.930	87.580			
3	.373	12.420	100.000			

Extraction method: Principal component analysis.

Component matrix(a)

	Component
	1
Training 1	.853
Training 2	.854
Training 3	.737

Extraction method: Principal component analysis.
a 1 components extracted.

Factor 6: Employee involvement and empowerment

Communalities

	Initial	Extraction
Employee 1	1.000	.722
Employee 2	1.000	.742
Employee 3	1.000	.622
Employee 4	1.000	.545

Extraction method: Principal component analysis.

Total variance explained

Component	Initial eigenvalues			Extraction sums of squared loadings		
	Total	% of variance	Cumulative %	Total	% of variance	Cumulative %
1	2.632	65.794	65.794	2.632	65.794	65.794
2	.799	19.973	85.768			
3	.386	9.638	95.405			
4	.184	4.595	100.000			

Extraction method: Principal component analysis.

Component matrix(a)

	Component
	1
Employee 1	.850
Employee 2	.862
Employee 3	.789
Employee 4	.738

Extraction method: Principal component analysis.
a 1 components extracted.

Factor 7: Communication

Communalities

	Initial	Extraction
Communication 1	1.000	.755
Communication 2	1.000	.773
Communication 3	1.000	.739

Extraction method: Principal component analysis.

Total variance explained

Component	Initial eigenvalues			Extraction sums of squared loadings		
	Total	% of variance	Cumulative %	Total	% of variance	Cumulative %
1	2.267	75.580	75.580	2.267	75.580	75.580
2	.391	13.034	88.614			
3	.342	11.386	100.000			

Extraction method: Principal component analysis.

Component matrix(a)

	Component
	1
Communication 1	.869
Communication 2	.879
Communication 3	.860

Extraction method: Principal component analysis.
a 1 components extracted.

Appendix 7 Multiple regression analysis

Variables entered/removed(b)

Model	Variables entered	Variables removed	Method
1	Leadership 1 Leadership 2 Leadership 3 Leadership 4 Leadership 5 Leadership 6 Leadership 7 Planning 1 Planning 2 Planning 3 Planning 4 Implementation 1 Implementation 2 Implementation 3 Implementation 4 Monitoring 1 Monitoring 2 Monitoring 3 Training 1 Training 2 Training 3 Employee 1 Employee 2 Employee 3 Employee 4 Communication 1 Communication 2 Communication 3 (a)	.	Enter

a All requested variables entered
b Dependent variable: Importance

Model summary

Model	r	r square	Adjusted r square	Std. error of the estimate
1	.628(a)	.394	.199	.49288

a Predictors: (Constant), Leadership 1, Leadership 2, Leadership 3, Leadership 4, Leadership 5, Leadership 6, Leadership 7, Planning 1, Planning 2, Planning 3, Planning 4, Implementation 1, Implementation 2, Implementation 3, Implementation 4, Monitoring 1, Monitoring 2, Monitoring 3, Training 1, Training 2, Training 3, Employee 1, Employee 2, Employee 3, Employee 4, Communication 1, Communication 2, Communication 3

ANOVA(b)

Model		Sum of squares	df	Mean square	F	Sig.
1	Regression	13.749	28	.491	2.021	.007(a)
	Residual	21.135	87	.243		
	Total	34.884	115			

a Predictors: (Constant), Leadership 1, Leadership 2, Leadership 3, Leadership 4, Leadership 5, Leadership 6, Leadership 7, Planning 1, Planning 2, Planning 3, Planning 4, Implementation 1, Implementation 2, Implementation 3, Implementation 4, Monitoring 1, Monitoring 2, Monitoring 3, Training 1, Training 2, Training 3, Employee 1, Employee 2, Employee 3, Employee 4, Communication 1, Communication 2, Communication 3
b Dependent Variable: Importance

Coefficients(a)

Model		Unstandardised coefficients		Standardised coefficients	t	Sig.
		B	Std. error	Beta	B	Std. error
1	(Constant)	3.028	.305		9.926	.000
	Leadership 1	.012	.081	.023	.151	.880
	Leadership 2	-.156	.096	-.320	-1.625	.108
	Leadership 3	.133	.066	.242	2.028	.046
	Leadership 4	.003	.078	.005	.033	.973
	Leadership 5	-.066	.073	-.132	-.906	.368
	Leadership 6	-.045	.086	-.091	-.524	.602
	Leadership 7	.013	.074	.027	.175	.861
	Planning 1	.042	.092	.073	.458	.648
	Planning 2	.036	.075	.059	.484	.629
	Planning 3	-.059	.089	-.109	-.659	.512
	Planning 4	.108	.094	.203	1.150	.253
	Implementation 1	.047	.087	.089	.542	.589
	Implementation 2	-.113	.096	-.208	-1.172	.245
	Implementation 3	-.106	.089	-.200	-1.192	.237
	Implementation 4	-.015	.080	-.029	-.183	.855
	Monitoring 1	.036	.063	.078	.572	.569
	Monitoring 2	.115	.067	.225	1.702	.092
	Monitoring 3	.066	.068	.143	.972	.334
	Training 1	-.043	.074	-.080	-.582	.562
	Training 2	-.042	.084	-.087	-.500	.618
	Training 3	.109	.068	.241	1.597	.114
	Employee 1	.010	.075	.022	.131	.896
	Employee 2	.027	.092	.061	.292	.771
	Employee 3	-.018	.082	-.035	-.223	.824
	Employee 4	.035	.071	.068	.497	.621
	Communication 1	.138	.076	.285	1.809	.074
	Communication 2	.040	.096	.076	.419	.677
	Communication 3	.019	.078	.036	.240	.811

a Dependent variable: Importance

List of publications:

- Pitinanondha, T., & Akpolat, H. 2005, Operational risk management systems in Australian organisations - a comparative study, *1st International Conference on Operation and Supply Chain Management*, Bali.

- Pitinanondha, T., & Akpolat, H. 2007a, Managing operational risks: a conceptual framework for operational risk management, *2nd International Conference on Operation and Supply Chain Management*, Bangkok.

- Pitinanondha, T., & Akpolat, H. 2007b, Managing operational risks: critical factors for operational risk management system, *8th International Conference on Operations & Quantitative Management*, Bangkok.