A Framework for Systematic Management of Operational Risks

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Abstract

This paper presents a theoretical research framework that was used to analyse operational risk management (ORM) system practices in Australia. It provides a new perspective on how to use national and international operational management system standards as a basis for systematic management of operational risks.

Based on the extensive literature review and the analysis of operational risk management system practices that are common in Australian organisations, this paper identifies the critical factors for effective use of an ORM system. The proposed framework could also be used as a model to research ORM system applications in other countries.

Key Words: Operations Management, Operational Risk, Risk Management, Operations Management Systems

1. Introduction

Business environment in 21st century is more complex than ever. Most businesses have to deal with uncertainties in every aspect of their operations. Operational risk differs from other types of risks as it deals with established processes rather than managing the unknown circumstances (Frame (2003). 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, just to name a few (Cooke 2004; Raz and Hillson 2005).

While in the financial and insurance fields, managing risks has been always a fundamental aspect of the business, in the typical manufacturing and service environments, operational

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risk management has been largely neglected (McFadden and Hosmane 2001). Many researchers dedicated their efforts more on improving operational efficiencies, which include reducing of process variability, increasing flexibility or implementing controls rather than systematically managing risks in operations (Cooke 2004).

Managing risks can be traced back to the turn of 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 the scientific management were the important foundation for the quality innovation. Around the 1930s, quality control was introduced by Walter Shewhart, who combined statistics with Lewis' Theory of Knowledge to control the variation of production processes and improve product quality (Shewhart 1939). Shortly after the end the World War II, Edward Deming taught Japanese engineers Shewhart's Theory of Variation, statistical process control techniques and "Plan-Do-Control-Act" cycle.

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 as the Total Quality Management (TQM) movement (Deming 1986).

The idea of quality management and improvement has been later adapted into other operational aspects including environment, occupational health and safety, and information security.

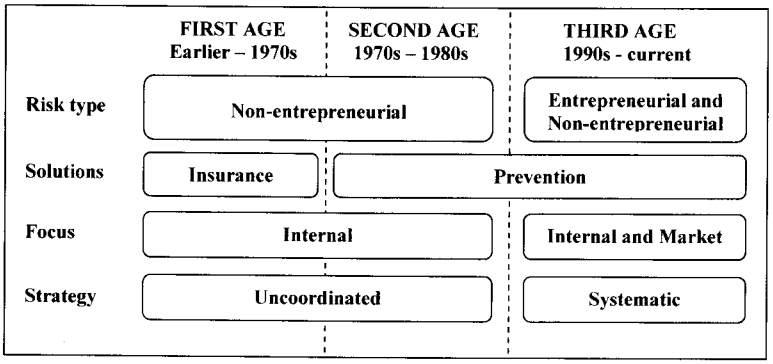

Figure 1. The three ages of risk management (Adapted from Sadgrove, 2005)

As part of this movement, several (national and international) management standards were also developed to help organisations to manage losses or risks in those operations (Brumale and 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 which seemed to incorporate many concepts and ideas of the quality movement.

According to Sadgrove (2005), the history of risk management can be generally breakdown into three ages as shown in Figure 1. 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. Waring (2001) points out that these contextual changes forced organisations around the globe to re-think their operational risk strategies. During the second age in the 1970s and 1980s, the organisations adopted various quality concepts to reduce the variation in the process as a proactive approach for managing losses. In the current and third age of ORM that begun around the mid of 1990s, organisations have been focusing on both internal and external risks and employing management system standards and frameworks as guidelines to systematically control risks.

2. Systematic management of operational risks

In the past few years, we have witnessed a growing number of books, articles and conferences dealing with topics related to operational risk management, as well as the development of a number of standards and guidelines that advise organisations on 'best practices' of managing risks in operations (Raz and Hillson 2005). The Table 1 depicts some of the most widely used national and international standards as well as professional standards and guidelines for operational risk management.

3. The status of ORM system implementation in Australia

At present, the approaches and methods preferred by Australian organisations for managing operational risk can be divided in three different groups. These are:

Table 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
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 Organisation for Standardisation	2000	Quality risks
ISO 14001: 2004, Environmental Management Systems-Requirements with Guidance for Use	International Organisation for Standardisation	2004	Environmental risks
ISO/IEC 17799: 2005, Information Technology-Security Techniques-Code of Practice for Information Security Management	International Organisation for Standardisation 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 Organisations of the Treadway Commission (COSO), USA	2004	All
New Basel Capital Accord-Consultative Document	Basel Committee on Banking Supervision, Switzerland	2001	All

Source: Adopted from Raz and Hillson (2005); Hillson (2006).

- ORM systems based on the risk management system standard AS/NZS 4360
- ORM systems based on the enterprise-wide risk management (ERM) frameworks
- ORM systems based on the management systems standards ISO 9001, ISO 14001, and AS/NZS 4801

3.1 ORM systems based on the AS/NZS 4360 (Risk Management System) standard

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 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.

In Australia, the approach outlined in the AS/NZS 4360 has been adopted by the 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 widely used as a risk management model. According to a survey conducted by the consulting and accounting firm KMPG among Australian firms, only 40% of the respondents have formal risk management strategies and policies in place (Tilley 1996). This seems to be mainly due to 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).

3.2 ORM systems based on the Enterprise-wide Risk Management (ERM) frameworks

Enterprise-wide risk management (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.

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; De Loach 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.

3.3 ORM systems based on the management systems standards ISO 9001, ISO 14001, and AS/NZS 4801

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 and 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 and SMS).

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 and Wiseman 1995; Maani 1994; Sohal *et al.*, 1992), EMS (e.g. Klassen and McLaughlin 1996; Sroufe 2003), and OHSMS (e.g. Lin and Mills 2001; Mohamed 1999)).

The relationship between quality management practice and organisational performance has been widely discussed 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 and Samson 1999). He also argues 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 and McLaughlin 1996; Lin and Mills 2001; Powell 1995; Sohal and Terziovski 2000; Zhang 2000). Other factors include communication (Sroufe 2003), employee empowerment (Powell 1995), training, involvement and review of the system (Sohal and Terziovski 2000).

In Australia, most organisations use the three management systems as stand-alone rather than as an integrated management system (Hasan and 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 (Akpolat and Xu 2002; Beechner and Koch 1997; Brumale and McDowall 1999; Jonker and Karapetrovic 2003; Karapetrovic 2003; Karapetrovic and 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 and Koch 1997; Karapetrovic and 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 and Karapetrovic 2003; Karapetrovic 2003).

3.4 Conclusions

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 and 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 and SMS models appears to be more common.

4. The proposed ORM system framework

The 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 and 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/constructs that relate to ORM system implementation based on the quality management system as well as risk management system implementation.

Table 2 shows the framework comparison among the ORM system elements/constructs in this study and others researches. The 'supplier relationship' and 'customer involvement' elements/constructs in Flynn *et al.*, (1994) framework, 'supplier quality management' element/construct in the Saraph *et al.*, (1989) framework, and 'customer focus', 'supplier quality management', 'benchmarking', and 'supplier performance' elements/constructs in Ahire *et al.*, (1996) framework were not included in this research framework since those elements/constructs focused on customer, supplier and competitors which are external to the organisation.

4.1 The proposed ORM system framework and research model

Figure 3 shows a research model that was developed based on the proposed ORM system framework. The following provides a brief definition of the three modules, namely top management, process management and human resource management, and the corresponding framework elements.

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 and McLaughlin 1996; Lin and Mills 2002; Powell 1995; Pun and Hui 2002; Rahman 2001; Sohal and 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

Table 2. Comparison of various frameworks

Framework	Elements/constructs
The proposed ORM system framework in this study	1: Leadership; 2: Planning and strategic alignment; 3: Implementation; 4: Monitoring and continuous improvement; 5: Training and performance appraisal; 6: Employee involvement and empowerment; 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; 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; 8: Employee relations.
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; 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.

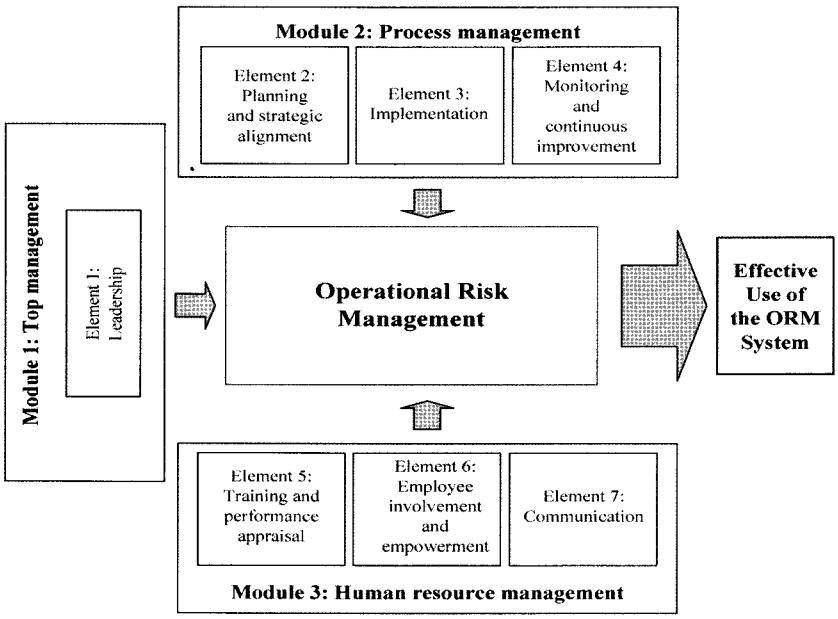

Figure 3. The proposed ORM system framework

force that can be used to drive the process (Kanji and 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.

Element 2: Planning and strategic alignment

Planning is one of the critical and core processes of a system and provides 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.

Element 3: Implementation

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.

Element 4: Monitoring and continuous improvement

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.

Element 5: 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-man-

agers (Dean and 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).

Element 6: 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.

Element 7: Communication

Communication is essential for any organisational initiative, problem identification and change management (Juran and 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.

5. Summary and Conclusions

This study provided 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).

A large number of researches in the field of operations management seem to deal primar-

ily with reduction of process variability, increasing flexibility or implementing controls in operations. For many researchers, managing risk in operations means reducing risks of producing nonconforming products or inadequate services (quality risks). In fact, the concept of ORM is not always clearly defined. However, regarding the effects and the success factors of an ORM system implementation, the majority of researchers seem to agree that the implementation of one or more operations management systems help reduce risks in operations.

A study of literature related to the ORM system implementation in Australia revealed that there was relatively a small number of research carried out about the critical success factors of an ORM system implementation. 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 authors suspect that lack of specific guidelines may have led to some of the unsuccessful ORM system implementations in Australia.

With the above contributions, this research establishes a foundation for ORM researchers to continue their future research on ORM system implementation. Although the proposed framework was based on the results of a study about ORM system implementation in Australia, the authors believe that due to its generic nature this framework can be used for study of ORM system implementations in other countries as well.

References

1. Affisco, J. F., Nasri, F., and Paknejad, M. J.(1997), "Environmental versus quality standards: an overview and comparison," *International Journal of Quality Science*, Vol. 2, No. 1, pp. 5-23.
2. Ahire, S. L., Golhar, D. Y., and Waller, M. A.(1996), "Development and validation of TQM implementation constructs," *Decision Sciences*, Vol. 27, No. 1, pp. 23-56.
3. Akpolat, H.(2004), "Six Sigma in Transactional and Service Environments," Glower, UK.
4. Akpolat, H. and Xu, J.(2002), "Integrated Management systems: Quality, Environment and Safety," *The Asian Journal on Quality*, Vol. 3, No. 1, pp. 85-90.
5. Anderson, E. W., Fornell, C., and Lehmann, D. R.(1994), "Customer satisfaction, market share, and profitability: Findings from Sweden," *Journal of Marketing*, Vol. 58, pp. 53-56.
6. Beasley, M. S., Clune, R., and Hermanson, D. R.(2005), "ERM: a report status," *Internal Auditor*, Vol. 62, No. 1, pp. 67-72.
7. Beechner, A. and Koch, J. E.(1997), "Integrating ISO 9001 and ISO 14001," *Quality Progress,*

February, pp. 33-36.

8. Brumale, S. and McDowall, J.(1999), "Integrated management systems," *The Quality Magazine*, Vol. 8, No. 1, pp. 52-58.
9. Cherrington, D. J.(1995), "The Management of Human Resources," Fourth edition, Prentice-Hall, Englewood Cliff, Prentice-Hall, New Jersey.
10. Commonwealth of Australia(1996a), "Guidelines for Managing Risk in the Australian Public Service," MAB/MIAC Report 22, AGPS, Canberra.
11. Commonwealth of Australia(1996b), "Managing Risk in Procurement-a Handbook," AGPS, Canberra.
12. Cooke, D. L.(2004), "The dynamics and control of operational risk," The University of Calgary, Alberta.
13. COSO(2004), "Enterprise risk management-Integrated framework," New York.
14. Dean, J. W. and Bowen, D. E.(1994), "Management theory and total quality: Improving research and practice through theory development," *Academy of Management Review*, Vol. 19, No. 3, pp. 392-418.
15. DeLoach, J. W.(2000), "Enterprise Wide Risk Management: Strategies for Linking Risk with Opportunity," Financial Times/Prentice Hall, London.
16. Deming, W. E.(1986), "Out of Crisis," Massachusetts Institute of Technology, Center for Advanced Engineering Study, Cambridge, MA.
17. DuBrin, A. J.(1995), "Leadership: Research Findings," Practice, and Skills, Houghton Mifflin Company, Boston.
18. Flynn, B. B., Sakakibara, S., Schroeder, R. G., Bates, K. A., and Flynn, E. J.(1990), "Empirical Research Methods in Operations Management," *Journal of Operations Management*, Vol. 9, No. 2, pp. 250-284.
19. Flynn, B. B., Schroeder, R. G., and Sakakibara, S.(1994), "A framework for quality management research and an associated measurement instrument," *Journal of Operations Management*, Vol. 11, pp. 339-366.
20. Frame, J. D.(2003), "Managing risk in organizations: A guide for managers," Jossey-Bass, San Francisco.
21. Gardner, D. H. and Winder, C.(1997), "Occupational health and safety management system," *Quality Assurance*, Vol. 5, No. 3, pp. 183-196.
22. Gordon, J., and Wiseman, J.(1995) "Thriving on competition," Business Quarterly, Spring, pp. 79-84.
23. Hasan., M. and Kerr., R. M.(2003), "The relationship between total quality management prac-

tices and organisational performance in service organisations," *The TQM Magazine*, Vol. 15, No. 4, pp. 286-291.

24. Hillson, D.(2006), "The Risk Management Universe: A guide tour", British Standards Institute, London.
25. Hopkin, P.(2002), "Holistic Risk Management in Practice," London, Wither by Australian CPA, Vol. 71, No. 10, p. 75.
26. Ishikawa, K.(1985), "What is Total Quality Control? The Japanese Way," Prentice-Hall, London.
27. Jonker, J. and Karapetrovic, S.(2003), "Integration of standardized management systems: searching for a recipe and ingredients," *Total Quality Management*, Vol. 14, No. 4, pp. 451-459.
28. Juran, J. M. and Gryna, F. M.(1993), "Quality Planning and Analysis," Third edition, McGraw-Hill, Inc., New York.
29. Kanji, G. K. and Asher, M.(1993), "Total Quality Management Process: A Systematic Approach," Advances in Total Quality Management Series, Carfax, Abingdon.
30. Karapetrovic, S.(2003), "Musings on integrated management systems," *Measuring Business Excellence*, Vol. 7, No. 1, pp. 4-13.
31. Karapetrovic, S. and Willborn, W.(1998), "Integration of quality and environmental management systems," *The TQM Magazine*, Vol. 10, pp. 204-213.
32. Klassen, R. D. and McLaughlin, C. P.(1996), "The impact of environmental management on firm performance," *Management Science*, Vol. 42, No. 8, pp. 1199-1214.
33. Kleffner, A. E., Lee, R. B., and McGannon, B.(2003), "The effect of corporate governance on the use of enterprise risk management: evidence form Canada," *Risk Management and Insurance Review*, Vol. 16, No. 1, pp. 53-73.
34. Knight, K. W.(2002), "Developing a Risk Management Standard-the Australian experience," *Safety Science*, Vol. 40, pp. 69-74.
35. Lam, S. S. K.(1995), "Quality management and job satisfaction: An empirical study," *International Journal of Quality and Reliability Management*, Vol. 12, No. 4, pp. 72-78.
36. Lin., J. and Mills., A.(2001), "Measuring the occupational health and safety performance of construction companies in Australia," *Facilities*, Vol. 19, No. 3/4, pp. 131-138.
37. Little, J. H.(1992), "Variation, Knowledge, and the Quality Movement," The 1992 Academy of Management Annual Meeting, 10 August 1992.
38. Maani, K. E.(1994), "Empirical analysis of quality management in manufacturing," *Asia Pacific Journal of Quality Management*, Vol. 3, No. 1, pp. 5-23.

39. Mann, R. S.(1992), "The Development of a Framework to Assist in the Implementation of TQM," PhD thesis, Department of Industrial Studies, University of Liverpool, UK.
40. McFadden, K. L. and Hosmane, B. S.(2001), "Operations safety: an assessment of a commercial aviation safety program," *Journal of Operations Management*, Vol. 19, No. 5, pp. 579-591.
41. McPhee, L.(2003), "Risk Management and Governance," *Canberra Bulletin of Public Administration*, Vol. 106, No. 1-8.
42. Mohamed, S.(1999), "Empirical investigation of construction safety management activities and performance in Australia," *Safety Science*, Vol. 33, No. 3, pp. 129-142.
43. Powell, T. C.(1995), "Total quality management as competitive advantage: A review and empirical study," *Strategic Management Journal*, Vol. 16, No. 1, pp. 15-37.
44. Pun, K., Hui, I.(2002), "Integrating the safety dimension into quality management systems: a process model," *Total Quality Management*, Vol. 13, No. 3, pp. 373-391.
45. Rahman, S.(2001), "A comparative study of TQM practice and organizational performance of SMEs with and without ISO 900 certification," *International Journal of Quality and Reliability Management*, Vol. 18, No. 1, pp. 35-49.
46. Raz, T. and Hillson, D.(2005), "A comparative Review of Risk Management Standards," Risk Management: An International Journal, Vol. 7, No. 4, pp. 53-66.
47. Sadgrove, K.(2005), "The complete guide to business risk management," England, Gower Publishing.
48. Saraph, J. V., Benson, G. P., and Schroeder, R. G.(1989), "An instrument for measuring the critical factors of quality management," *Decision Sciences*, Vol. 20, pp. 810-829.
49. Scipioni, A., Arena, F., Villa, M., and Saccarola, G.(2001), "Integration of management systems, Environmental Management and Health," Vol. 12, No. 2, pp. 134-145.
50. Sharman, R.(2002), "Enterprise Risk Management-the KPMG approach," The British Journal of Administrative Management, May/June, Vol. 31, p. 26.
51. Shewhart, W. A.(1939), "Statistical method from the view point of quality control," Washington DC: The Graduate School of the Department of Agriculture.
52. Sohal, A. S., Ramsay, L., and Samson, D.(1992), "Quality management practice in Australia industry," *Total Quality Management*, Vol. 3, No. 3, pp. 283-299.
53. Sohal, A. S. and Terziovski, M.(2000), "TQM in Australian manufacturing: factors critical to success," *International Journal of Quality and Reliability Management*, Vol. 17, No. 2, pp. 158-167.
54. Sroufe, R.(2003), "Effects of environmental management systems on environmental management practices and operations," *Production and Operations Management*, Vol. 12, No. 3, pp.

416-431.

55. Standards Australia and Standard New Zealand(2000), "HB250-2000 Organisational Experiences in Implementing Risk Management Practices," Sydney and Wellington.
56. Taylor, F. W.(1911), "The principles of scientific management. Reprint," 1967, Norton Company.
57. Tena, A. B. E., Llusar, J. C. B., and Puig, V. R.(2001), "Measuring the relationship between total quality management and sustainable competitive advantage: A resource-based view," *Total Quality Management*, Vol. 12, No. 7-8, pp. 932-938.
58. Terziovski, M. and Samson, D.(1999). "The link between total quality management practice and organisational performance," *International Journal of Quality and Reliability Management*, Vol. 16, No. 3, pp. 226-237.
59. Tilley, K.(1996), "Risk program lag in Australia, survey shows," *Business Insurance*, Vol. 30, No. 35, p. 2.
60. Tilley, K.(1997), "Risk undermanaged down under (Risk management in Australia)," *Business Insurance*, Vol. 31, No. 16, pp. 41-42.
61. Waring, S.(2001), "Risk Ready," Australian CPA, Vol. 71, No. 10, p. 75.
62. Zhang, Z.(2000), "Developing a model of quality management methods and evaluating their effects on business performance," *Total Quality Management*, Vol. 11, No. 1, pp. 129-137.