A REVISED FRAMEWORK FOR MANAGING CONSTRUCTION HEALTH AND SAFETY RISKS BASED ON ISO 31000

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There is an increasing demand being placed on those managing construction projects to complete their work efficiently; while also ensuring that the risks associated with financial, environmental protection, health, safety and quality are simultaneously managed effectively. The international risk management guideline ISO 31000, adopted in Australia as the joint Australia and New Zealand AS/NZS ISO 31000 (2009), has been suggested in order to represent one of the best integrated frameworks that can be used for managing all types of risks. However, apart from the guidance notes and supporting documentation, there is little published research that supports such claims. For this reason the utility of managing construction health and safety risks effectively, using the above standard on its own, remains questionable. The aims of this paper are threefold. Firstly, it gives a brief introduction to the new risk management guidelines and its adoption in Australia. Secondly, it critically reviews the published literature on the above risk management standard. Thirdly, it discusses three main differences between the risk management standard and health and safety management practice. The paper concludes with a proposed revised framework based on ISO 31000 that can be used to manage construction health and safety risks more effectively.

Keywords: risk management, ISO31000, construction health and safety management, hazard identification, risk treatment and control.

INTRODUCTION

Effective management of construction health and safety risks is an integral part of construction work. It is becoming evident that those charged with the responsibility of managing health and safety risks in many organisations are increasingly expected to either draw upon, or adopt, strategies and measures that can simultaneously achieve other risk management objectives, including that of environmental protection, finance and quality management. This, in part, is driven by the recognition that health and safety needs to be integrated into all decision making processes (Sunindijo & Zou, 2014), with the development of an international standard for risk management in the form of ISO 31000 being suggested to provide necessary mechanism for such integration (International Organization for Standardization, 2009).

The idea of integrating health and safety into the decision-making process is not only necessary, but also long overdue. However, apart from the guidance notes and supporting documentation, published research on this standard is limited, even though construction risk management itself continues to be the subject of significant research (Jefferies & McGeorge, 2008; Yaraghi and Langhe, 2011). Very little attention has been given to the framework needed to support the implementation of risk management process in the construction industry (Sousa, De-Almeida, & Dias, 2012). This is a significant gap in the literature, and begs the question of whether a blanket adoption of this risk

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standard on its own is enough for managing health and safety risks in the industry? This research attempts to fill this gap through an integrative review of the literature on construction health and safety management and risk management.

RESEARCH METHODS

The research method used in this research involves an integrative review of the literature, consistent with that used by Corina and Palaneeswaran (2010) and Vincent, Taylor-Adams, and Stanhope (1998). The efficacy of document reviews as research method has been previously established (Mogalakwe, 2006).

The remaining sections of this paper discusses the development and implementation of the above risk management standard, reviews research based on risk management; and goes on to examine three main differences between the risk management standard and health and safety management practices. The paper concludes by proposing a revised framework which integrates the key ideas derived from the review.

THE DEVELOPMENT OF ISO 31000

The new risk management standard was published by the International Organization for Standardization (ISO) in 2009. Titled ‘Risk management- principles and guidelines’, it represents the concerted efforts by a working group of international technical advisors from a range of industries and backgrounds (Gjedrum & Peter, 2011). This development is a very important achievement. While those working in, or associated with risk management have always sought to make decisions about risks, the acceptability of those risks, and the reliability of information required to make the necessary decisions about the levels of risk, their ability to do so mainly depended upon how risks were defined; the different aspects of the process involved and what these processes sought to achieve (Purdy, 2010). This meant decision-makers were left to resolve pieces of similar but fundamentally different information obtained from different processes, with different assumptions and; in some cases described using the same words but with different meanings. In this regard one of the main challenges for ISO was to reach consistency and reliability in risk management through a standard that could be applied to all forms of risk.

ISO 31000 has evolved over two decades when the need for a global and improved risk management approach was first realised in the 1990s. Initially, these were aimed at addressing societal concerns associated with safety standards and environmental impacts of new technologies and products (Mitchell, 1990). In seeking to be truly international in nature, a number of different approaches, guidelines and standards were considered, some examples of which are illustrated in Table 1. The development and adoption of ISO 31000 occurred over a period of four years, involved twenty-nine countries and underwent three major revisions before being adopted (Dali & Lajtha, 2012). As a result the new guideline has been suggested to be more relevant as it can used in a range of countries and organizations, irrespective of the complexity, size or type (International Organization for Standardization, 2009).
Table 1: Some approaches for managing risk prior to ISO 31000

<table>
<thead>
<tr>
<th>Standard</th>
<th>Author</th>
<th>Year</th>
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<tbody>
<tr>
<td>IEEy 1540 (2001): IEEE standard for software</td>
<td>Institute of Electrical and Electronic</td>
<td>2001</td>
</tr>
<tr>
<td>life cycle processes - risk management</td>
<td>Engineers</td>
<td></td>
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<tr>
<td>and implementation of risk management system</td>
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<tr>
<td>project risk management - application</td>
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<td>guidelines</td>
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<tr>
<td>standard</td>
<td>Forum for Risk Management in the Public</td>
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<tr>
<td></td>
<td>Sector/Association of Insurance and Risk</td>
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<td>Managers</td>
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For countries such as the United States, this development represented an expansion of the practice of risk management; a field which evolved out of industrial safety and insurance (Gjedrum & Peter, 2011). The complexity of construction work, combined with the fact that construction work is undertaken by small, medium and large organisation suggests that ISO 31000 is relevant in advancing risk management practice in the industry.

The Joint Australian/New Zealand Standard for Risk Management

The first risk management standard adopted in Australia was the joint Australian and New Zealand Standard AS/NZS 4360 Risk management, which has been suggested to represent the first standard on the subject (Flaus, 2013). Since its inception in 1995, this standard has been revised twice, first in 1999 and again in 2004 (Standards Australia, 2009). The latter addition took into account feedback of some ten years of user experience, before being proposed to the ISO. Hence the first draft of ISO 31000 replaced AS/NZS 4360 (Leitch, 2010). The current joint Australian and New Zealand risk management standard is based on ISO31000.

KEY ELEMENTS OF ISO 31000

ISO 3100 is based around five main chapters /clauses, viz:

1. Scope;
2. Terms and definitions;
3. Principles;
4. Framework; and

Of particular interest to construction safety academics, policy makers and practitioners are the last three chapters, and these are briefly considered next.

Principles

ISO 31000 lays out a set of eleven key principles that organisations need to follow. As worded, an effective framework for risk management is expected to

1. create and protect value;
2. be a central part of all organizational processes;
3. be part of all decision-making;
4. address uncertainty;
5. be systematic, structured and timely;
6. be based on the best information available;
7. be tailored to the needs of the individual organization;
8. take into account human and cultural factors;
9. be transparent and inclusive;
10. be dynamic, iterative and responsive to change; and
11. facilitate continuous improvement (International Organization for Standardization, 2009).

In effect, these have been suggested to represent the essential performance criteria against which risk management can be assessed, evaluated or measured (Purdy, 2010).

**Framework**

ISO 31000 stresses the use of a framework that fully integrates the management of all types of risks likely to be experienced by an organization. Authors such as Gjedrum and Peter (2011) have noted the framework can be used to provide an assurance that the organization-wide processes for managing risks are supported, iterative, continues to remain effective, and provides the necessary mechanism for integration, reporting and accountability; hence needs to include some ways of monitoring and reviewing. According to Luko (2013), it also includes core supporting organizational structure, mandates and overall management. In some respects this is tantamount to the Plan-Do-Check-Act (PDCA) cycle of continuous improvement suggested by Deming, although the jargon may be different. It is important to note that the "framework is not intended to prescribe a management system, but rather to assist the organization to integrate risk management into its overall management system" (International Organization for Standardization, 2009, p. 11). One way by which construction organizations which already have established management systems for environmental protection, health and safety, and quality assurance can achieve this is by integrating these management systems into the organisation's risk management approach.

**Process**

Effective risk management involves a series of integrated and coordinated activities aimed at directing and guiding an organisation in relation to risk (Flaus, 2013). ISO 31000 suggests these can be grouped into five steps:

1. communicate and consult;
2. establishing the context;
3. risk assessment;
4. risk treatment; and
5. monitoring and review (International Organization for Standardization, 2009).

Steps 1 (communicate and consult) and 5 (monitoring and review) have been suggested to be included in the main steps of establishing the context, risk assessment and risk treatment.

**CONSTRUCTION RISK MANAGEMENT**

Risk management of construction health and safety has been the subject of much research, resulting in an ongoing body of reviews on the subject. Examples of these include Walters (2010), for example, examined the effectiveness of consultation; Bhattacharjee, Ghosh, and Young-Corbett (2011) who reviewed commonly used techniques used for improving construction safety; Swuste, Fritjers, and Guldenmund (2012) who examined structures, processes, safety management systems and responsible for safety; and a Cochrane review of...
the effectiveness of technical, human factors, organisational interventions and regulations (van der Molen et al., 2012). None of these reviews used ISO 3100 as a framework or point of reference.

There has been some published research around this standard. Ciocoiu and Dobrea (2010) examined standardizations in improving the effectiveness of an integrated risk management strategy and concluded the development of an ISO standard on risk management meant an appropriate tool was available internationally for formalize the process and harmonizing the best practice approach. Oehmen, Ben-Daya, Seering, and Al-Salamah (2010) examined the adoption and application of ISO 31000 in product design and concluded that; while the suggested five step process was relevant, the published literature addressed different aspects of them to varying degrees, and there was generally a lack of integration between the suggested standards and processes. Gjedrum and Peter (2011) compared ISO 31000 with the Enterprise risk management framework developed by the Committee of Sponsoring Organizations of the Technology Commission (COSO) and found that a major difference between the traditional processes of managing risks and the new guideline was the inclusion of 'establishing the context' and continuous 'communication and consultation'; and that the main strengths of ISO 31000 lay in the identification of risk owners. Luko (2013) reviewed the terminology and language used the new guidelines as adopted in the United States as ANSI/ASSE Z690.2 -2011, and concluded that ISO 31000 did provide a good framework upon which applications for managing quality and risks could be expanded upon.

At the time of preparing this paper, ISO 3100 has been the subject of two construction risk management papers. The first, by Liu, Low, and He (2011), examined the practices and challenges of implementing Enterprise Risk Management (ERM) modelled on ISO 31000. This research revealed that the construction organisations generally had a basic understanding of risk management and a relatively clear focus on market and financial risks, most had an established risk management system, and the main means of managing risks involved behavioural control. The second, by Sousa et al. (2012), proposed a framework for managing construction risks by integrating a model of Organizational management (OM), the PDCA cycle, the five step risk management process, the key functional areas, management processes and the different stakeholders involved in construction projects.

Based on a review of the above literature, the following points can be made. First, there is generally a level of acceptance that ISO 3100 is about harmonization of existing process, although there is very little published on (i) the principles and their adoption and/or utility in measuring performance, and (ii) the efficacy (or otherwise) of suggested five step process. Second, ISO 31000 enables some level of integration into the different business and other risk management processes, although it is unclear how this can be achieved in actual practice. Two possible alternatives suggested include ERM and OM, however, both these approaches are likely to be more relevant to large organisations, but the extensive frameworks suggested can prove difficult (if not costly) for medium and small sized constructions which comprise the bulk of the construction sector. Some authors, including Leitch (2010) have commented that overall, the standard itself is disappointing, and attributing this to the difficulties with language and country of origin of the representatives involved in developing and finalising
ISO 31000. However this is normal, and expected, in the development of any standard aimed at an international level of adoption.

On a more pragmatic level those of us who practise in health and safety, occupational hygiene or ergonomics can point out a number of differences between what is included in ISO 31000 and health and safety management in practice. The next section discusses these differences.

KEY DIFFERENCES BETWEEN THE RISK MANAGEMENT STANDARD AND HEALTH AND SAFETY MANAGEMENT

There are at least three main differences between ISO 31000 and health and safety management practice which can impact on the effective management of health and safety risks in construction. These differences largely involve the process of risk management.

The first is the inclusion of 'establishing the context;' a concept which is not featured in health and safety management practice. According to Sousa et al. (2012), this step involves evaluating and understanding the internal and external contexts, the challenges faced by the organisation, factors which can impact on the achievement of goals, the broader risk management strategy. The authors contend that asking six key questions around who (stakeholders/parties), what (design), which way (activities), why (motives), wherewithal (resources), and when (timing) can assist in identifying the key parameters. Flaus (2013), suggests it is a "stage in formalizing the definition of the framework…it allows us to define the object…interactions with the environment, the nature of risks being studied … consequences…scales of probability and severity, the risk matrix and thresholds of acceptability"(Flaus, 2013, p. 64). This stage of the process can be distilled into four (4) key inputs:

1. External environment;
2. Internal environment;
3. Risk management framework; and
4. Risk criteria.

External environment includes those forces and institutional factors outside an organisation that can potentially affect its performance (Robbins, Bergman, Stagg, & Coulter, 2006), and can include factors such as economics, political/legal, socio-cultural, demographics, technological, global, industrial, clients/customers, competitors, suppliers, stakeholders (International Organization for Standardization, 2009; Standards Australia, 2009). Internal environment includes factors such as culture, goods and services provided, technology, pressure groups, policies /procedures/rules, internal politics, work practices, management and supervisory styles, and degree of change experienced (International Organization for Standardization, 2009; Standards Australia, 2009). The most common frameworks used in health and safety management practice include AS/NZS ISO 4801/4804, 9001, 14000 and OHSAS 1800, or its equivalent in the United States. Consequences, probability, severity, risk matrices and acceptability are terms that are associated with the risk assessment process itself (Flaus, 2013).
The second key difference is the notion of 'risk identification', which ISO 31000 suggests is the first part of the risk assessment process. This term itself is confusing, and represents a significant point of departure from health and safety research and practice. Risk itself is a controversial issue in many fields of practice; in the context of health and safety risk management it is associated with a degree of harm, injury or illness (Boyle, 2012) and is only possible if someone is exposed to a hazard (Flaus, 2013; Jensen, 2012). Being able to determine the degree involves making some level of determination based on a number of aspects, including exposure, consequence and severity; hence is the subject of some level of calculation or manipulation, either quantitatively or qualitatively! This, in effect, sees risk as the outcome of a manipulated process. Health and safety standard and guidance, and adopted universally in practice, relate more to the notion of identifying hazards, which, in its broadest sense, refers to anything that has the potential to cause harm (Boyle, 2012; Jensen, 2012). For that reason it is more appropriate to use the term hazard identification instead of risk identification, for risks cannot be identified, but hazards can.

Related to the notion of risks in the standard are the terms risk analysis and risk evaluation; each of which have a different meaning. According to ISO 31000, analysis involves a “comprehending the nature of risk to determine the level of risk” (Standards Australia, 2009, p. 5); while evaluation involves “comparing the results of risk analysis with risk criteria to determine whether the level of risk is acceptable or not” (Standards Australia, 2009, p. 6). In this respect there are two different outcomes of analysis and evaluation of risks:

- from risk analysis - an understanding of the nature and level of risk, and
- from evaluation - decision about whether level of risk is acceptable or not!

Health and safety standards and guidance, and universally adopted in practice, refer to the simpler process of 'risk assessment' which takes into account both analysis and evaluation. This is best summarised by Rausand (2011) who defines risk assessment as 'the overall process of risk analysis and risk evaluation' (p.9). Summarising these two ideas gives us the main difference into the notion of risk between ISO 31000 and health and safety risk management practice. In the latter, risk includes determining the level of risk (hence the process of risk analysis) and a decision about whether this level of risk is acceptable or not (risk evaluation); but this is based on the hazard, not risk, as suggested in the former. So the two sets of coordinated activities to support communication, consultation and establishing include:

1. hazard identification (instead of risk identification); and
2. risk assessment (which includes risk analysis and evaluation, but not risk identification).

The third difference is the notion of 'risk treatment', which the standard suggests can be achieved in the seven key ways; which Flaus (2013) summarises into four:

1. transfer;
2. terminate;
3. treat; and
4. tolerate
The use of the term treatment seeks to suggest that an adverse outcome is a normal expectation of risk management. This represents one of the key philosophical problems with this line of thinking when applied to health and safety, which has at its core the main objective of preventing harm, illness, injury or diseases; not treatment! For these reasons health and safety standards and guidance, as adopted universally in practice, refer more to risk control rather than risk treatment.

A REVISED FRAMEWORK FOR HEALTH AND SAFETY RISK MANAGEMENT

While there are other subtle and minor differences in terms of language, definitions and terminology, the ones discussed above are those will cause confusion and apprehension among those seeking to use ISO 31000 for advancing the practice of health and safety risk management. For this reason a revised framework is proposed, illustrated in Figure 1, which integrates the processes suggested in ISO 31000 and universally adopted health and safety management practice.

![Diagram of the revised framework for managing construction health and safety risks]

Figure 1: Proposed framework for managing construction health and safety risks

The revised framework incorporates the six key steps:

1. Communication and consultation;
2. Establishing the context;
3. Identifying hazards;
4. Assessing risks;
5. Controlling risks;
6. Monitoring and reviewing.
4. Assessing risks
5. Controlling risks; and

In suggesting the above, users can replace the process shown in Clause 5 of ISO 31000 with Figure 1 above. This will ensure some level of consistency and harmonization of the commonly used practices for managing health and safety risks, while allowing for the integration of key principles and framework proposed by ISO 31000.

CONCLUSIONS, LIMITATIONS AND FUTURE RESEARCH

ISO 31000 provides a set of eleven principles which constitute the key performance criteria against which risk management can be managed and supported with a series of integrated and coordinated activities arranged as a five step process. A review of the literature suggests little empirical research has been conducted on the actual application of ISO 31000. There are at least three fundamental differences in (1) the conceptualization and understanding of risks; (2) the actual processes management of these risks from the different domains of quality, environment and health and safety; and (3) control of risk instead of treatment. A revised framework is proposed which integrates the process of risk management suggested in ISO 31000 and the actual practice of health and safety management. In presenting the revised framework it is not suggested that the process suggested in ISO 31000 is irrelevant, in fact it is more so, because it enables users to integrate health and safety into an organisation's broader risk management strategy. What the revised framework allows for is for users to adopt and/or modify based on their needs.

It is recognised the proposed framework is theoretical in nature and is yet to be tested empirically. In this regard it serves as an invitation to researchers, academics and practitioners to explore the opportunities afforded by the revised framework to progress the vision zero agenda in construction. Future research questions which can be explored include the utility of the eleven principles of risk management for assessing health and safety performance, experiences and pitfalls in the application of the different processes for managing health and safety risks, comparative analysis of the proposed framework as applied in small and medium-sized companies, and developments in risk control and/or treatment.

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