

# A whole of supply chain systems approach to addressing workplace safety risk management

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## Introduction

There is a growing interest in addressing workplace safety risks along the supply chain (Safe Work Australia, 2015a). This is due to two major reasons. First, there is a high human cost and adverse economic implications of such risks. For example, in Australia, it is estimated that work-related injuries and illnesses cost \$60 billion or around 5 per cent of GDP annually. Second, increasing numbers of Australian organisations are relying on other organisations (domestic and overseas) for their inputs, business activities and performance along various supply chains.

In general, supply chains are sequences of contractual arrangements for the provision of goods and/or services. The term 'supply chain' has been defined by Handfield and Ernest (1999) as encompassing 'all activities associated with the flow and transformation of goods from raw materials stage (extraction), through to the end user, as well as the associated information flows. Material and information flow both up and down the supply chain.' Supply chain management is 'the integration of these activities through improved supply chain relationships to achieve a sustainable competitive advantage' (Handfield and Ernest, 1999). The practices of outsourcing (or offshoring where the good/service is sourced from overseas) and multi-tiered subcontracting are integral to many supply chains. Over the past several decades, local and international supply chains have become universal in many (if not most) industries in Australia and overseas (Gregson et al., 2015).

WorkSafe has identified that it is important to develop supply chain mapping techniques which will have future generic application to better manage workplace safety from a 'whole' of supply chain perspective. This position is supported by the findings from a recent previous related work (see Sohal and Chen, 2012). Sohal and Chen (2012) have indicated that a supply chain perspective is absent from workplace safety risk management models. Also, safety risk management practices at present are dominated by a focus within organisations without taking the supply chain into account.

The key issues to explore in the context of this evidence review are to:

- investigate and review the current literature available in supply chain mapping techniques;
- investigate current models and best practice in relation to supply chain safety risk management as a new perspective into workplace safety;
- determine the key drivers of workplace safety in the context of whole of supply chain risk management; and
- identify the barriers or constraints to addressing workplace safety along the whole of supply chain; and propose how to overcome those barriers.

Workplace health and safety issues are relevant to all organisations irrespective of whether they are part of a supply chain. However, the particular nature of supply chains in terms of

the formal business interdependency of individual organisations within a supply chain makes the participating organisations more vulnerable to changes in the status of workplace health and safety issues of one organisation or many along the supply chain. This is due to the direct and indirect flow on consequences (on products, materials, services and processes) of any health and safety breaches of some organisation/s on others along the supply chain upstream or downstream (including suppliers, sub-suppliers). Managing these flow-on consequences along global/regional supply chains are particularly challenging due to cross-border issues such as reliance on imported inputs, machinery, plant and equipment from various overseas sources with different safety standards and workplace health and safety regimes.

There are several key drivers that could have an adverse impact on workplace safety along supply chains in a globalised and highly commercial oriented operating environment. First, some of the domestic and international organisations participating along various supply chains may possess inadequate systems to address workplace safety related issues as a source of risk along the supply chains. Second, different and numerous commercial contractual arrangements between organisations along the supply chains can limit the ability of those organisations engaged in the provision of various goods and services to invest in risk management measures to prevent potential workplace safety risks. Third, some of the small and medium size organisations operating along the supply chains may have limited resources to invest in health and safety measures, including management time, training and investment in new equipment and plant. Fourth, the highly cost-sensitive nature of the activities driven by intense competition along a supply chain could also lead some organisations to compromise or even not comply with workplace safety responsibilities. Fifth, the inefficiencies associated with some subcontracting may include poorer communication, overly complex or mismatched safety systems, lower standards of training, induction and supervision and an inability of workers to organise for their own safety. Sixth, the leaner and more integrated supply chains become, the more likely workplace safety related incidents in one link affect the other links in the supply chain. Finally, there could be regulatory failures or gaps in regulation, inconsistent standards and inadequate enforcement of workplace health and safety legislations (James et al., 2007, Norrman and Jansson, 2004, Gregson et al., 2015).

We attempt to explore these issues in this paper with particular attention to a whole of supply chain systems approach to addressing workplace safety risk management. Hence, this paper is set out to address the question: What tools/frameworks/mechanisms are available to map and address workplace health and safety risks over entire supply chains in general? We attempt to answer this question by undertaking a systematic evidence review of the relevant published academic literature and other related published sources publicly available.

The format of the paper is as follows. The next section will briefly explain the methodological approach we have undertaken to conduct the systematic evidence review. Section three will present the key findings from our review. In section four, we discuss the key insights

emerging from our findings. The final section provides some concluding remarks in relation to developing a holistic health and safety risk management overarching framework.

## **Methodology**

We conducted a systematic review of the published literature relating to supply chain risk management tools and techniques on workplace health and safety. Our review is largely based on empirical literature available on Google Scholar database. Furthermore, we use additional and relevant publicly available published material through other sources such as industry organisations and government websites in Australia and key OECD economies.

Our search strategy involved the use of following search terms in combination: (tools or approaches or techniques or mechanisms or frameworks) and (supply chain risk management) and (workplace health and/or safety). The above search terms were also specifically applied to alcoholic glass manufacturing, as well as, to glass manufacturing.

The search was limited to English language publications, a time duration range 1990 – present and peer reviewed academic journals predominantly.

The studies included in the evidence review were required to meet the following inclusion criteria: reported on any tools, approaches, techniques, mechanisms, frameworks used to address work place health and safety risk management along supply chains. The studies which focused on the management of risks other than workplace health and safety along the supply chain were excluded.

## **Results**

A total of 21 academic journal articles were identified through the database search. We reviewed the abstracts of all the 21 academic journal articles. We found 12 full-text articles eligible for full review. These 12 studies were included in our review. Based upon the inclusion criteria, no published literature was found with specific reference to the alcoholic glass manufacturing and glass industry.

In addition to these 12 academic journals and through a web search process, a further 8 industry reports/government publications were deemed relevant to the evidence review. Other published matter covered some of the issues relevant to our subject matter area and were also deemed appropriate for this paper.

The published evidence identified covered a wide range of countries including Australia, Brazil, China, European Union, UK and USA, and several industries ranging from automotive, construction and food to manufacturing.

Our systematic review has indicated several approaches/tools/techniques that have been used to address health and safety risks along supply chains. Accordingly, the results from our systematic review of the published literature presented below are organised around three sets of approaches/tools/techniques (1. health and safety auditing instruments, 2. health and safety regulation/legislation/standards, and 3. supply chain risk management tools) that the existing literature suggests have important relevance for addressing workplace health and safety risks along supply chains.

### ***Health and safety auditing instruments***

Four studies (see Costella et al., 2009; Berman and Swani, 2010; Zou, 2011; Gnoni et al., 2013;) reported the importance of using health and safety audits as tools/techniques to address health and safety risks along supply chains.

Using the Brazilian automotive industry as a case study, Costella et al., (2009) have illustrated the importance of undertaking three main auditing approaches to health and safety management for medium-sized and large industries positioned in highly competitive supply chains. The three approaches included the structural approach (which assesses the system prescribed), the operational approach (which assesses what is really happening on the shop-floor) and the performance approach (which assesses the results of performance indicators).

Berman and Swani (2010) have suggested (in their analysis of imported Chinese goods to the US as a case study) the use of 'product safety audits' as a mechanism to ensure that the products from out-sourced organisations meet health and safety requirements. These audits can be conducted by a product safety coordinator, a product safety committee or an independent consultant of the importing firm. Such a mechanism is expected to secure greater control over raw material sourcing, use extreme care in choosing subcontractors, conduct continuous product testing by multiple parties, being especially vigilant for counterfeits, and improve product traceability (Berman and Swani, 2010).

By reviewing the safety management programs implemented by five construction companies along their supply chains in the United States, Australia, and Hong Kong, Zou (2011) has developed a conceptual model for managing health and safety in the construction sector. The conceptual model has highlighted the need for safety risk management systems to support ongoing monitoring through reporting, auditing, and reviewing safety performance, as well as updating communications and procedures. Furthermore, Zou (2011) has emphasised in his model the need to engage the entire supply chain and every project stakeholder, each of whom has interest in and influence over construction safety.

Based on a case study involving an international company in the automotive supply chain in Europe, Gnoni et al., (2013) have shown a set of 'operational tools' where safety issues are directly analysed. These 'operational tools' are identified as Knowledge Sources (KSs) used periodically to discuss and evaluate safety management. Gnoni et al., (2013) have identified two types of KSs: bottom-up and top-down. The bottom-up approach is focussed on the workers in the firm whereas the top-down approach is aimed to verify target levels such as zero injuries in a year. Regular audits (six monthly) of health and safety risks and planned corrective actions were part of the overall set of these 'operational tools'. The focus of the audits was to verify compliances against standards (defined by a specific legislation or internally by the firm). A potential challenge facing this approach was that it required a substantial effort of the firm's management. Hence, this approach could be effective only with a full involvement of all levels of management from top managers to supervisors (see Gnoni et al., 2013).

### ***Health and safety regulation/legislation/standards***

Eight studies (Vickers et al., 2005; James et al., 2007; Cantor 2008; Lloyd and James, 2008; European Agency for Safety and Health at Work, 2012; Rawling and Kaine, 2012; Gregson et al., 2015; Nossar et al., 2015) highlighted the usefulness of relevant regulation/legislation/standards as tools that can be used to address workplace health and safety risks along supply chains.

Vickers et al., (2005) analysed the responses to statutory health and safety requirements in small organisations in the UK based on a wide survey. They have pointed out that differences in awareness, attitudes and compliance with respect to health and safety regulation/legislation by small organisations in UK are related to a number of factors. External pressure and influence as a result of being part of a supply chain has been identified as an important positive factor in this regard. Other factors include firm size, the presence/absence of external pressures due to inspections by regulators, the training, experience and attitudes of owner/managers, and the market position of organisations and their financial health (Vickers et al., 2005).

James et al., (2007) have examined how British health and safety laws could be utilised to address workplace health and safety risk management along supply chains. According to their analysis workplace health and safety regulations could address the health and safety risks along the supply chains in several ways. First, they could provide those organisations at the top of supply chains with greater regulatory and financial incentives to contribute to the better management of health and safety within them. Second, they could give those organisations lower down such chains a greater financial motivation to manage workplace health and safety effectively and greater access to health and safety knowledge and expertise.

Third, such regulations could enable existing resources for compliance monitoring and enforcing to be used more effectively. They have also argued that those organisations at the top of the supply chains are likely to be relatively 'reachable' by workplace health and safety regulators. This is partly because of their greater visibility and number. Hence, it could be argued that any non-compliance by these organisations has a reasonable likelihood of detection, with the consequent risks that this entails in terms of enforcement action and the imposition of penalties, as well as related reputational damage (James et al., 2007). Consequently, such regulation can potentially support an inspection 'multiplier effect', whereby workplace health and safety inspectors can influence health and safety in the 'many' organisations along the supply chain by action within a 'few'.

Cantor (2008) has highlighted the importance of regulation as a tool to address health and safety risks along supply chains. He has pointed out the role that regulatory agencies can provide in monitoring and enforcing workplace safety rules and regulations along the supply chains, using US examples in the areas of hazardous industries including construction and manufacturing. Cantor (2008) argued that regulatory agencies could create better working environments by introducing rules and regulations, and conducting inspections of many workplace settings across several different types of industries.

Lloyd and James (2008) have examined the impact of supply chain pressures on the UK food processing industry and the implications for occupational health and safety. According to their analysis, the regulatory framework and the ability to call upon law and the Health and Safety Executive (HSE) (the body responsible for enforcing health and safety laws in the UK) has been identified as a particularly important strategy in addressing health and safety risks in the food processing industry. They have pointed out that moves to use the supply chain to improve health and safety have to take into account the direct and indirect ways that pressures are exerted and the continued imbalance of power between buyers and suppliers along the food processing industry supply chains in the UK.

In a review of promoting occupational safety and health through supply chains, European Agency for Safety and Health at Work (2012) has pointed out that successful attempts to influence businesses in promoting workplace health and safety throughout their supply chains often involve mixed forms of regulation, in which top-down state regulation is combined with market-based measures and initiatives. The review has indicated that industries such as the chemical industry act in a different context than, for example, the clothing and textile sector. The size of companies and their supply chain is another important factor (local supply chains of small companies cannot, for example, be compared with large, international supply chains of multinational enterprises).

In examining the occupational health and safety issues of base level workers in the vertical supply chain of the Australian road transport industry, Rawling and Kaine (2012) have argued that separation of occupational health and safety obligations from minimum pay standards

presents difficulties for the effective prevention of accident, injuries and fatalities in the road transport industry. Given these shortcomings of traditional regulation, they have pointed out the need for a system of 'safe pay rates' (that is rates where quantum and payment structure do not compel unsafe driving practices) by regulating all of the parties in the transport supply chain.

An important cross-border issue in supply chains relates to continuing and growing reliance by domestic organisations on imported inputs, machinery, plant and equipment from various overseas sources with different safety standards and workplace health and safety regimes. In the absence of enforceable international labour, and health and safety standards on global supply chains (Gregson et al., 2015), it is difficult to address these cross-border related health and safety related risks along global/regional supply chains. Gregson et al., (2015) have discussed some recent attempts to move towards reciprocal arrangements to address issues along international supply chains, particularly in the area of offshore maintenance, repair and overhaul of Australian aircrafts under bilateral aviation safety arrangements. While such bilateral arrangements provide a framework for extending workplace health and safety related regulatory reach where supply chains cross national borders, there are several limiting factors. These include, for example, the differences in workplace health and safety regulatory arrangements between countries and issues of national sovereignty which make the most powerful inspectorate tool – unannounced and mandatory inspections – more difficult. Gregson et al., (2015) have pointed out that although, undertaking effective regulatory oversight of workplace health and safety across national boundaries is challenging, it can be explored through a combination of global standards and tightly coupled contractual obligations that are rigorously enforced through strong compliance measures.

Nossar et al., (2015) have analysed the parallel interaction of two legal developments within the Australian textile, clothing and footwear industry supply chain: the mandatory contractual tracking mechanisms; and the duties imposed by the harmonised Work Health and Safety Acts. They have argued that there is no obvious impediment (other than a lack of political will) preventing the regulation of transnational supply chains extending into the jurisdiction of a domestic government. In principle, an organisation selling goods/services within a domestic economy could be required to include contractual provisions into contracts with overseas suppliers and disclose information about the overseas location of production of goods/services and the conditions under which those goods/services are produced.

The assessment of Nossar et al., (2015) in relation to regulation of transnational supply chains is important particularly in the context of health and safety issues relating to cross-border issues such as reliance on imported inputs, machinery, plant and equipment, and tools from various overseas sources with different safety standards and workplace health and safety regimes. The global supply chain activities that Australian organisations are part of have undergone significant change over the past several decades. Reliance on imported inputs and equipment has become a common aspect of the Australian industrial and manufacturing

supply chains due to changes in trade regimes and relative costs. According to Safe Work Australia (2015b), work-place related injuries and fatalities are often associated with the unsafe design of machinery, plant and powered tools. Many of the various types of equipment used in Australian workplaces are designed and manufactured overseas. This can result in inappropriate equipment being brought to and used in Australia, because of varying safety standards in other countries (Safe Work Australia, 2015b).

### ***Supply chain risk management tools***

Norrman and Jansson (2004) have described a supply chain risk management tool that has been developed and used by Ericsson (a leading telecom company), after a fire at a sub-supplier, with a huge impact on the company. The stages of the supply chain risk management tool described by Norrman and Jansson (2004) to address workplace health and safety can vary from risk identification/analysis (or estimation) via risk assessment (or evaluation) to different ways of risk management.

In theory, assessing and prioritising workplace safety risks could be quite a straightforward and quantitative task. However, in practice and along a supply chain with multiple organisations involved, this could be a subjective process relying on specialists' judgements (see Norrman and Jansson, 2004).

Quantifying the potential value of workplace safety risks may not be easy. Hence, in addition to human costs some organisations focus on the financial impact when assessing and prioritising supply chain risks. For example, to quantify the financial value of the impact of a particular workplace safety risk, a firm may calculate the 'business interruption value'. This can be defined by gross margin multiplied by the 'business recovery time' plus extra costs such as idle capacity of labour and equipment, inventory carrying etc. According to Norrman and Jansson (2004), Ericsson's business interruption costs due to the fire at a sub-supplier were calculated as approximately US \$200 million.

Another important aspect to consider here is the values such as lost goodwill due to business interruptions resulting from workplace safety risk events. Estimation of the 'business interruption value' enables organisations to compare it with the cost of different preventive actions to avoid or reduce workplace safety risks along supply chains (see Norrman and Jansson, 2004).

### **Discussion**

We undertook a systematic search of peer-reviewed literature, relevant reports from industry associations, regulatory bodies and government agencies with a particular focus on approaches/tools/techniques/mechanisms which explicitly considered workplace health and safety risk management issues along supply chains. As can be seen from the number of relevant publications covered in this paper such specific analysis is very limited. Based upon

current research and this literature review, there is clearly a gap in workplace safety risk management tools being widely propagated and used along whole of supply chains.

Although typically the key asset and therefore the major priority of an organisation is its employees, workplace safety practices are a seldom discussed and an under-investigated source of risks to supply chain management (James et al., 2007, Cantor, 2008). Gregson et al., (2015) and Nossar et al., (2015) argued that research and analysis into supply chains and occupational health and safety is still in its infancy.

The results of our systematic review of the literature have shown that at least three key sets of approaches/tools/techniques/mechanisms are available and being used to address workplace safety issues along the supply chains by some organisations to a varying degree. They include the use of health and safety auditing instruments, health and safety regulation/legislation/standards, and supply chain risk management tools with respect to health and safety risks at the workplace. Workplace safety risk management tools are focused within organisations and not across actual supply chains. It should be acknowledged, many organisations are very committed and have excellent health and safety management systems in place for their organisations, however, the effective application of these systems both upstream and downstream are limited.

Health and safety auditing instruments have several strengths: the ability to detect failures from strategic issues (e.g. lack of top management commitment) to operational ones (e.g. lack of safeguards in some equipment) (Costella et al., 2009); the independent nature of the health and safety auditing process; and the ability to suggest areas for improvement and provide a framework to assess an organisation's overall health and safety readiness (Berman and Swani, 2010),

The limitations of the health and safety auditing instruments include: the need for both representatives of the organisations and examiners to know about details of the auditing process; the length of time required to apply the auditing tools and the data collection and analysis (Costella et al., 2009); and the need for ongoing budget for auditing as well as a contingency budget in the event of a major health and safety incident (Berman and Swani, 2010). Also the auditing requires substantial involvement and effort of all levels of management in an organisation (Gnoni et al., 2013).

Health and safety regulation/legislation/standards have several strengths: the recognition that well-implemented health and safety regulation and associated mechanisms of support will have financial benefits for the business by better shaping the performance and development of enterprises (Vickers et al., 2005); and a 'safety net' in the form of a regulatory framework (where management of some organisations are 'uncommitted' actors) in facilitating workplace health and safety risk reduction (Lloyd and James, 2008);

The challenges in implementing health and safety regulation/legislation/standards include: a relatively low level of awareness of relevant health and safety legislation in small firms; a reactive stance of small firms towards regulation; and poor compliance due to the difficulty that some firms experience in compelling resistant employees to adhere to the legislative requirements (Vickers et al., 2005).

A major strength of the supply chain risk management tool discussed earlier (see Norrman and Jansson, 2004) is that it has a solid foundation based on ISO 31000 and it covers aspects of risk identification, risk assessment and risk treatment (see Supply Chain Risk Leadership Council (SCRLC), 2011). Also it encourages organisations to map their supply chains so that it can help a firm identify the workplace safety risks it faces and how best to prioritize and address them. A key challenge with this tool is that organisations may need to use their ratings of the likelihood and consequence of risks before and after treatment to evaluate residual risk levels against acceptable risk levels, that is, their risk tolerance. It is important to recognise that total elimination of all the risks associated with workplace health and safety along a supply chains is virtually impossible. This is because of issues such as reliance on inputs, machinery, plant and equipment, and tools from imported sources with different safety standards and workplace health and safety regimes.

It needs to be highlighted that depending upon the industry involved, the impact and 'number of degrees' of upstream and downstream along the supply chain in relation to the use of workforce health and safety risk management tool will vary considerably. Due to factors already stated such as the size of the organisation, international or local, senior management's commitment to risk management, there is a significant deficiency of consistent and effective approaches of health and safety risk management being applied across the whole of supply chains. This highlights the fact that what is needed is to advocate and encourage the use of these existing tools more widely within a consistent framework which can be applied across all industries and at the same time, recognising the uniqueness and the specific differences pertaining to each industry.

For example, there are favourable implications of using the existing tools such as health and safety regulation/legislation/standards. According to Safe Work Australia (2013), introduction of workplace health and safety regulations can lead to changes in safety practice and ultimately to changes in work health and safety outcomes for those businesses that: see themselves as being in an industry with significant hazards; and are larger businesses, and can interpret and apply the regulations to their specific circumstances. Large organisations are more likely to understand what they need to do in order to comply with workplace safety regulations as they are also more likely to be concerned about their reputation. Moreover, organisations that perceive themselves as operating in a high risk industry are more likely to attend to new regulations as they are introduced.

This is also supported by the European research. According to European Agency for Safety and Health at Work (2012), policy makers need to consider development of regulations that will stimulate appropriate responses on the part of both focal companies within supply chains and relevant trade and industry bodies. They also need to address how to best utilise the cooperation of other bodies, such as those outside the narrow business interests represented within the supply chains themselves.

Workplace health and safety inspections by the regulators are more likely to lead to improved work health and safety outcomes for small organisations and for those with no prior experience of inspections. This is likely to reduce the severity of workplace injuries rather than the overall injury rate. Furthermore penalties may be more effective for medium and large organisations in improving compliance against workplace health and safety regulations (Safe Work Australia, 2013).

Mechanisms such as awareness of workplace health and safety requirements, organisations' understanding of what they need to do to comply with relevant workplace safety regulations, concern for reputation, and perception of their level of risk are expected to affect work health and safety behaviours and compliance with regulation by many organisations (Safe Work Australia, 2013).

In order to facilitate an increased use of existing tools of supply chain health and safety risk management discussed in this paper, it would be useful to identify the barriers to the adoption of these tools and focus on ways to overcome them. This would be a key consideration in the development of a proposed framework for the next phase of this project. This is based on the recognition that each industry will have its own unique set of barriers and concerns across its respective supply chain.

The barriers to adoption of workplace safety risk management tools along the supply chains may relate to attitudes, beliefs and values that certain organisations may have in relation to workplace safety (see Commonwealth of Australia, 2006). For example, some organisations may not feel sufficiently threatened by the likelihood of injury or accidents to alter their current behaviours. The potentially serious consequences of workplace accidents, injuries and fatalities may not appear to be given a great deal of consideration by such organisations. Such organisations may view that the application of common sense is all that is required to avoid injury and accidents at the workplace. As the literature already highlights, this is not the case.

Because workplace injuries and accidents do not present as a major business risk, some other organisations may not consider safety risk management to be a high priority relative to other priorities. Some of these organisations may regard raising financial performance and minimising costs above workplace safety risk management. This reflects the misconception that workplace safety requirements and financial considerations could be competing priorities for some organisations along the supply chains.

Several steps can be taken to drive workplace safety risk related behavioural change of organisations and hence overcome the barriers to adoption of workplace safety risk management measures along the supply chains. These may include: emphasising the benefits of workplace risk management by carefully and continuously identifying the benefits of safe work practices so that these can be incorporated into the industry campaign messages; providing realistic, practical and low cost workplace risk management options; and targeting workplace safety messages to specific industries and sectors, and specific worker groups taking into account the changing demographics and the diverse nature of the workforce (see Commonwealth of Australia, 2006).

It is important to recognise that over the past several decades the Commonwealth Government, state and territory governments, industry associations, research bodies and private entities have invested significant resources and effort into improving workplace safety in Australian industries ranging from the construction sector to the manufacturing industries.

More recently, the management of workplace health and safety risks in Australia has progressed towards the establishment of the Australian Work Health and Safety (WHS) Strategy 2012-2022. This Strategy builds on the work of the National Occupational Health and Safety (OHS) Strategy 2002-2012 and provides a framework to drive improvements in work health and safety in Australia. It promotes a collaborative approach between the Commonwealth, state and territory governments, industry and unions and other organisations to achieve the vision of healthy, safe and productive working lives. The Australian WHS Strategy sets out four outcomes to be achieved by 2022. These include reduced incidence of work-related death, injury and illness, achieved by reduced exposure to hazards and risks using improved hazard controls and supported by an improved work health and safety infrastructure (see <http://www.safeworkaustralia.gov.au/sites/SWA/about/Publications/Documents/873/Australian-WHS-Strategy-1st-Progress-Report.pdf>). The strategies used on a regular basis by workplace health and safety regulators in Australia include introducing regulations, conducting inspections, imposing penalties for non-compliance and running industry campaigns (Safe work Australia, 2013).

This evidence review has identified that there is certainly a lack of safety risk management mapping tools across the whole of supply chain. Given the current evidence presented, it is proposed that such a safety risk management tool is required for Australian industries. At the very outset, it is proposed that such a safety risk management mapping tool needs to be based upon a flexible and holistic framework which draws upon the key principles, elements and evidence presented in the above discussion. As part of phase 2 of this project, we would also investigate the application of the key principles contained in Safe Work Australia's *Safe Design of Structures* whereby the integration of safety risk identification, control and monitoring measures are recognised early in the process and would be applied across the whole of the supply chain. The risks would then be assessed against frequency and potential degree of

harm. Given the changing nature of supply chains to meet their changing needs and demands, the proposed framework would also include a review process. This would ensure a commitment to continuous improvement and that the hierarchy of control in managing risks remain both current and applicable to the respective supply chains.

Given the lack of current safety risk management mapping tools across supply chains, it needs to be highlighted that there are no specific performance indicators for such a framework and these would need to be carefully considered in the next phase of development. Phase 2 of this project would also require a significant 'buy-in' by WorkSafe, regulators, government and industry groups, health and safety representatives, unions and organisations, both upstream and downstream. It is also suggested that an overarching framework should be developed as a trial based upon the requirements of an identified priority industry contained in the Australian Work Health and Safety Strategy 2012-2022.

Although, in general, workplace safety in Australia has improved considerably over the past several decades, the complex and globalised nature of supply chain activities that many Australian organisations experience has highlighted the gaps and the needs for better understanding of the related issues.

## **Conclusion**

Efficient and effective workplace safety risk management along the supply chains are expected to encourage safe and healthy worker behaviour, discourage unsafe and unhealthy worker behaviour, reduce injuries and improve worker safety, enhance the performance of organisations, reduce the compliance costs related to work safety regulation, minimise any risks to the reputation of organisations and help reduce insurance premiums (see Safe work Australia, 2013).

A key insight emerging from the evidence review and analysis in this paper is the need for increased adoption of workplace health and safety risk management tools/techniques/mechanisms/approaches along the supply chains.

The increased adoption of the tools/mechanisms/techniques identified in this systematic evidence based research survey will require committed leadership; proper governance arrangements, preparedness for change management and the development of a business case (see Supply Chain Risk Leadership Council (SCRLC), 2011).

As highlighted in the literature, it is most effective and vital to have the full sponsorship of the leadership of an organisation in relation to workplace safety risk management. It is important to also ensure that workplace health and safety risk-management processes are embedded into business-function processes in order to ensure effective and regular communication and staff collaboration on relevant issues.

Proper governance arrangements for an effective workplace health and safety risk management along the supply chains will include details on meeting structure, attendees, standard agenda items and deliverables relating to health and safety risk reductions and the associated business processes. This will require effective co-operation and collaboration of all stakeholders upstream and downstream from the respective organisations. It must also be highlighted that key bodies such as WorkSafe will have a major role in the governance and compliance of the implementation of such a safety risk management mapping tool across supply chains.

Establishing or improving workplace health and safety along a supply chain in most cases represents a major change for many organisations. There are several reasons for that including: the presence of many organisations of varying sizes and geographic locations (both domestic and international) who are interlinked downstream and upstream through the provision of supplies and processes; different emphasis on managing various sources of risks such as product delivery versus inventory management versus workplace health and safety; and differences in the nature and compliance requirements of workplace health and safety regulations/legislations facing different organisations (domestic and international) along the supply chain.

It is expected that many domestic organisations are fully aware of their responsibilities and duty of care in relation to workplace health and safety under their respective jurisdictional legislations and regulations. However, this may not necessarily be the case for some overseas organisations who are key partners along global supply chain arrangements. Consequently, implementation of workplace safety risk management will need to pay particular attention to the tenets of successful change management.

By developing and implementing a holistic health and safety risk management overarching framework along supply chains we have the opportunity to positively contribute to cost savings by protecting staff from injuries and fatalities associated with hazardous or harmful products and processes, continue to change workplace safety behaviour and improve Australia's workplace health and safety performance across the whole of supply chains.

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