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Safety and Multi-employer Worksites in High-risk Industries: An Overview
Sécurité au travail et lieux de travail multi-employeurs dans les industries à hauts risques : une vue d'ensemble
Seguridad ocupacional y lugares de trabajo multi-patronales en las industrias de alto riesgo: una visión general

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Article abstract

This paper focuses on safety on multi-employer worksites in high-risk industries. Relevant industries are those that utilize flexible labour arrangements and specialization, such as construction, mining and petroleum production, and that traditionally have been high-risk due to hazards in the physical work environment and the occurrence of unsafe work processes and practices. These industries also share common characteristics in matters of overall work environments, multi-employer worksites (including subcontracting chains), as well as tasks performed by contractors, making it relevant to explore and clarify the situation regarding the safety of the affected groups. A comprehensive review is performed of 43 peer-reviewed research articles published up until early 2015, with a main focus on international studies covering safety issues on multi-employer worksites in construction and industrial work settings such as mining, petroleum production and manufacturing.

The results show that previous research has focused on a number of key issues that may be divided into three broad categories: 1- contract work characteristics; 2- structural/organizational factors and conditions; 3- cultural conditions. Much of the focus is on structure and organization, for example, how multi-employer arrangements can lead to breakdowns in communication and overall disorganization effects in relation to safety. There is, however, a need for further studies on the nature of these structural and organizational factors and conditions, such as focused studies on the consequences of power asymmetry for the ability of contractors to adhere to safety laws and regulations. Furthermore, we argue that the development towards blurred organizational boundaries in these networks due to extensive outsourcing and long-term contracts may be a worthwhile avenue for future research into safety on multi-employer worksites.

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Safety and Multi-employer Worksites in High-risk Industries: An Overview

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In this paper, workplace safety in high-risk industries is explored in relation to outsourcing and multi-employer worksites. Relevant industries in this case are those that traditionally have been high-risk due to hazards in the physical work environment and the occurrence of unsafe work processes and practices, such as construction, mining and petroleum production. After conducting a comprehensive literature review, we compile a number of key terms and concepts that have been the subject of interest among researchers and divide them into three broad categories: 1- contract work characteristics; 2- structural/organizational factors and conditions; 3- cultural conditions. We conclude by discussing the results in terms of challenges for safety in these shared work settings as well as suggest directions for future research.

KEYWORDS: safety, multi-employer worksites, outsourcing, subcontracting, contractors.

Introduction

For the past century, work organization based on flexible labour arrangements and specialization has been common in some industries, such as construction (Johnstone *et al.*, 2001; Weil, 2014). Over the course of the last 30 years, however, globalization and changing economic policies and deregulations worldwide have led to the expansion of these practices to include many more industry sectors. Responding to increased competition and market fluctuations, large organizations in both the public and private sectors have progressively turned to outsourcing as a means of cutting expenditures and arranging for more flexible workforces

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(Koukoulaki, 2010). Usually this entails keeping core activities in-house while more specialized and/or peripheral services, such as maintenance and cleaning, are performed by contractors on-site within the outsourcing company's facilities (Johnstone *et al.*, 2001; Quinlan, 1999). A contractor also often hires subcontractors, usually smaller firms, to assist in fulfilling the contract. These subcontractors can, in turn, bring in other sub-subcontractors, leading to long subcontracting chains and, eventually, complex networks of chains and individual companies working side by side or in close proximity to each other (Nunes, 2012).

Although outsourcing/subcontracting is common both in the public and private sectors in most industrialized countries, some industries pose more of a risk when it comes to workers' safety, such as construction and mining (Weil, 2014). These have traditionally been high-risk due to hazards in the physical work environment and the occurrence of unsafe work processes and practices (Radomsky *et al.*, 2001). Coupled with the possible fragmentation of work organization on multi-employer worksites in these industries, this may create further structures of vulnerability affecting safety 'vertically' (in the specific chains themselves) as well as 'horizontally' on the multi-employer worksite as a whole (Ustailieva *et al.*, 2012). For example, in a comprehensive audit in connection to WorkSafe Tasmania, Quinlan (2014) underlined that the use of contractors in mining operations warrants particular attention when it comes to safety, as the presence of more or less temporary workers may alter the level of risk at the worksites. Focusing on occupational injuries in the US coal mining industry, Pappas and Mark (2011) showed that contractors have had higher injury rates compared to mining company personnel since the early 1990s, although the levels have begun to converge in recent years. Research on health (including occupational injuries) and safety in the small companies that tend to perform contract work in general also points to the problem of upholding safety standards when resources are scarce and profit margins are thin, which often is the case for these groups (Cunningham and Sinclair, 2015; Sinclair and Cunningham, 2014). These pressures, then, may lead to increasingly unsafe working conditions on multi-employer worksites (Weil, 2014). Overall, it can be argued that industries such as mining, construction and petroleum production share common characteristics in matters of overall work environments, multi-employer worksites (including subcontracting chains), as well as tasks performed by contractors. This makes it relevant to explore and clarify the situation in the various industries regarding the safety of the affected groups.

The purpose of this study was to carry out a survey and analysis of research articles focusing on safety on multi-employer worksites in high-risk industries. The aim was to summarize and describe the state of the art of the research in this field and draw conclusions from the accumulated results.

Methodology

The literature review includes peer-reviewed research articles published up until early 2015. Similar to Walters and James (2011), three methods were applied to determine the relevant literature: 1- searches in major and well-renowned scientific databases, 2- identification of relevant articles from research fields other than strictly safety science (i.e. 'grey' literature), and 3- an examination of cited references from articles derived from these searches. This approach was deemed appropriate due to the multitude of research areas that potentially would be relevant for the study in question. The databases searched in the first step were EbscoHost, Google Scholar, ProQuest, Scopus, and Web of Science, using the search words: safety, health, safety management, accident(s), occupational health and safety, occupational safety and health, work/working conditions, and injury/injuries. These were used in various combinations with the search words outsourcing, contract work, multi-employer worksite(s), inter-organizational network(s), (sub)contracting, contractor(s), and subcontractor(s). The industry-specific search words selected to restrict and focus the results were construction, mining, and petroleum/gas/oil industry. The different databases and search engines have different characteristics and capabilities, but, by and large, most searches were performed on article title, keywords and abstract. The 'grey' literature, in this case, was examined by searching the databases mentioned above more open-endedly by using a more limited number of general search terms such as outsourcing and subcontracting in conjunction with, for example, fragmentation. After performing the various combinations of searches, reading relevant abstracts and examining cited references, 43 articles were eventually selected through the strength of the studies (e.g. methods, sample-size, scope of the literature reviewed, etc.) and their relevance in relation to safety, contractors and multi-employer worksites. These articles—most of which have been published in the last 15 years (Table 1)—were finally included in the review under four thematic headings highlighting particular safety-related aspects that emerged from the reading of the texts (Table 2). A few articles were also included under more than one heading. Despite the scope of the literature review, there is no guarantee that the present study has not missed relevant research. These potential misses should, however, not affect the overall results.

TABLE 1
Number of included articles and their publication time

Published (year)	Number of articles
<1999	6
2000-2009	20
2010-2015	17
Total	43

TABLE 2

Thematic headings, included articles and publication time

Heading	<1999	2000-2009	2010-2015
Accidents and injuries	Blank *et al.* (1995) Rousseau and Libuser (1997) Collinson (1999)	Quinlan and Bohle (2008)	Nenonen (2011) Saleh and Cummings (2011) Muzaffar *et al.* (2013) Lamare *et al.* (2015)
Structure and dynamics of multi-employer worksites	Baugher and Roberts (1999)	Berggren *et al.* (2001) Aronsson (2001) Aronsson *et al.* (2002) Waring (2003) James *et al.* (2007) Flecker (2009)	Wagenaar *et al.* (2012)
Safety management	Rebitzer (1995) Mayhew *et al.* (1997)	Lingard and Holmes (2001) Johnstone *et al.* (2005) Loosemore and Andonakis (2007) Bust *et al.* (2008) Gunningham (2008) Calizaya *et al.* (2008) Hovden *et al.* (2008) Hui *et al.* (2008) Quinlan and Bohle (2008) Quinlan *et al.* (2009) Schubert and Dijskstra (2009)	Wadick (2010) Jacobsson (2011) Walters and James (2011) Biggs *et al.* (2013) Cameron *et al.* (2013) Dahl (2013) Nenonen and Vasara (2013) Starren *et al.* (2013) Votano and Sunindijo (2014)
Safety culture and safety climate		Fuller and Vassie (2001) Clarke (2003) Molenaar *et al.* (2009)	Lingard *et al.* (2010) Wadick (2010) Rosness *et al.* (2012) Biggs *et al.* (2013) Bahn (2013)

The criteria for including and excluding articles were thus research focus and relevance. Some of the articles highlight general structural and organizational aspects and were included due to their generalizability. However, most of the included articles focus specifically on safety in construction and industrial work settings, i.e. multi-employer worksites in high-risk industries. In the case of the broader occupational health and safety (OHS) literature, focus was primarily on articles underlying safety issues and/or where occupational injury was a health outcome studied.

A note on terminology

In practice, there are numerous ways in which the term 'contractor' is applied in connection to outsourcing and subcontracting, usually to indicate the relative position of a company in a subcontracting chain. Variations include, for instance, 'general contractor', 'main contractor' and 'subcontractor'. However, in some industries, the traditional way of organizing the work with a general contractor as a focal point for the contracting arrangement (such as in construction) does not apply. Rather, it is the client company itself that brings in contractors directly. This too may result in subcontracting chains of various lengths, but not necessarily in relation to a general contractor in the traditional sense. As a consequence of this, the term 'contractor' and variations thereof is used in a number of different ways in research as well. Some studies make a clear distinction between 'contractors' and 'subcontractors', whereas in others, the companies involved are simply called 'contractors', leaving the 'sub' prefix aside. Alternatively, all contractors performing work in a network of any kind may be labelled 'subcontractors' exclusively. Complicating matters further, in some cases, 'contractors' is used to signify both firms (i.e. companies supplying labour or materials through contract work) and their employees (i.e. an employment type) at the same time. All in all, this may lead to confusion in terms and concepts.

This literature review used the term 'contractor' as referring to all companies (including one-person firms) supplying services or materials through contract work, i.e. a distinction was made between a given company and its workers.

Multi-employer worksites in high-risk industries

Accidents and injuries

Although outsourcing is common in many different industries, there are seemingly few studies focusing on the nature of accidents occurring on specific multi-employer worksites. One reason for this may be difficulties in obtaining comprehensive data and injury statistics from these work settings (Blank *et al.*, 1995; Saleh and Cummings, 2011). In a literature review on the more general

OHS effects of outsourcing and home-based work, Quinlan and Bohle (2008) found that out of the 25 reviewed studies, 92% showed adverse outcomes. The studies included a number of different OHS indices such as occupational injury, hazard exposure and disease. According to the authors, this wide array of outcomes makes it difficult to draw any definitive conclusions from the OHS literature regarding if, for example, outsourcing leads to certain workers (e.g. contractor employees) being exposed to specific safety risks and hazards.

Rousseau and Libuser (1997) proposed that the risk of accidents in work involving contractor employees and other contingent workers may be analyzed at two levels: 1- the individual level, involving possible risk for personal injury, and 2- the context level, i.e. risk of being injured in the work setting. At the individual level, in-house personnel were pictured as being less accident-prone compared to contingent workers due to better training, higher socialization and general familiarity with the work environment. At the context level, risks and hazards at joint workplaces may increase, as the presence of contingent workers introduces uncertainties and inconsistencies into the work environment for all parties involved, such as unpredictability in the use and placement of equipment. Contingent workers are generally also more susceptible to cost-cutting pressures, which tend to affect safety awareness in a negative way. Furthermore, perceived inequity (e.g. contractor workers being paid less or treated worse) has also been associated with substandard performance behaviours such as negligence and low-level cooperation that, by extension, may lead to an increased risk of accidents.

In a study of fatal accidents in the Finnish manufacturing industry, Nenonen (2011) identified a number of factors most commonly associated with fatal outcomes in outsourced operations: 1- deficiencies in instruction and guidance, 2- dangerous work practices, 3- insufficient hazard identification, and 4- human error. Most of the fatal accidents occurred during installations and preparations and maintenance work, and were precipitated by trapping, crushing, impact with an object, and contact with electricity, temperature or hazardous materials. Notably, most of the victims were deemed as experienced in the work tasks they were performing in connection to the accidents. Overall, in-house personnel also suffered the same modes of injury as the workers involved in outsourced operations. Similarly, Blank *et al.* (1995) found that most accidents involving contractor workers in the Swedish mining industry occurred during manufacturing, construction and maintenance work, i.e. tasks likely performed outside of the production itself. Both employment conditions and wage systems were seen as possible antecedent conditions contributing to the emergence of accidents with contractor employees, for example, having piece rates to a larger extent compared to in-house personnel. A conclusion was drawn that a large

part of the dangerous work in Swedish mining at the time was performed by contractors and that they may have suffered more injuries and of a more severe nature compared to the client companies. In a more recent study in the US mining industry, Muzaffar *et al.* (2013) found that the odds of sustaining a fatal injury versus non-fatal injury were almost three times higher for contractor employees, a relationship that remained significant even after controlling for factors other than employment type. Using the Pike River Mine explosions in New Zealand in 2010 as a case study, Lamare *et al.* (2015) also underlined the vulnerability of contractors in mining. An analysis of the accident, which claimed the lives of 29 workers (13 of which were contractor workers), showed that a failure to regulate the heterogeneous workforce, i.e. a lack of effective safety management system, meant that the workers were free to move around in the hazardous work environments underground. As a result of this, there was a general confusion over the extent of the disaster in the days following the initial explosion. Overall, contractor workers were seen as particularly vulnerable in terms of working conditions and safety. Similar findings were made by Collinson (1999) in a study of the North Sea oil industry, where contractor employees' working conditions were significantly inferior compared to those of workers directly hired by the operator. Not only did contractors perform most of the dangerous work tasks on the platforms, there was also evidence of the workers being treated as 'second class citizens' in general, being looked down on by the operator personnel. The consequences for safety were also evident, with contractor workers being involved in 29 out of 30 serious accidents reported at one of the studied installations.

Structure and dynamics of multi-employer worksites

One way the consequences of outsourcing and the emergence of multi-employer worksites have been described is as fragmentation, with implications for safety. In a study on large-scale engineering projects, Berggren *et al.* (2001) highlighted the fragmentary nature of multi-employer worksites, where the coordination of activities may suffer due to the complex communication and excessive bureaucratization inherent in large projects. Focusing on the repercussions of organizational fragmentation in modern working life, James *et al.* (2007) argued that overall political and economic (e.g. neoliberal) influences on work organization do not necessarily lead to negative health and safety-related outcomes. Client companies may still have a vested interest in making sure that the working conditions of temporary workers are up to standard, since incidents of any kind in high-risk production environments can have potentially catastrophic consequences. However, the fragmentary nature of a multi-employer worksite itself may have adverse effects on contractors' safety, since the contract work tasks tend to go to small or medium-sized companies often lacking resources

and required management systems to perform the work safely. Outsourcing and subcontracting frequently also lead to a fragmentation of previously integrated production processes and work tasks, with numerous companies working side by side under separate management control, making coordination and joint safety measures more complicated (James *et al.*, 2007). Analyzing outsourcing in a range of manufacturing and service industries, Flecker (2009) argued that the stretching of labour processes over organizational boundaries may result in the fragmentation of employment and work. Fragmentation in this case refers to differing employment contracts and terms and conditions among the external parties involved, performing tasks that were previously done by the client company. This may lead to part of the external labour force being less protected and consequently suffering worse working conditions.

Another perspective on modern industrial work settings characterized by multi-employer arrangements is that they constitute a core-periphery structure. The core consists of mostly in-house personnel working directly for the client company while the periphery is dominated by contractor workers and other contingent workers. In general, in-house personnel have high job security, strong union support and opportunities for personal and competence development (e.g. skills training). Contractors in the periphery, on the other hand, assuring organizational flexibility, work on temporary assignments and the employees may lack the traditional occupational securities and benefits afforded those in the core of the structure (Aronsson, 2001). Aronsson *et al.* (2002) hypothesized that a network with a strong central core will elicit processes aimed at keeping organizational stability and safety in that core by deflecting uncertainty towards the periphery, i.e. to the temporary workers and temporary work organizations. Contractors in the periphery of the networks, often times being in a dependent situation, could then be seen as the 'carriers' of this uncertainty. Wagenaar *et al.* (2012) showed that a multilayered core-periphery structure may lead to a sense of decreasing autonomy and task demand on the part of temporary workers, as well as a higher sense of job insecurity. This sense of insecurity was also found by Baugher and Roberts (1999) in their study of temporary workers in the petrochemical industry, where eight times as many contractor employees compared to in-house personnel reported having experienced general employment insecurity in the preceding year. According to the authors, this insecurity also likely made the contractor employees more anxious about workplace hazards while, at the same time, being less likely to exercise their rights to not perform blatantly unsafe work, in fear of losing their position.

However, in recent years, the distinction between core and periphery has begun to erode in some industries, where more and more of what were previously core activities instead are being outsourced. In a study of the rise of temporary

employment in the Australian mining industry, Waring (2003) showed that it has become increasingly more common for contractors to perform core tasks, such as shot firing and overburden removal, in black coal mining. In some companies, the entire mining operation had even been outsourced and, consequently, also the complete spectrum of risks connected to it. The idea of risks being transferred to the periphery of the network and thus 'cushioning' the workforce in the core has also been questioned in research. Flecker (2009) argued that core workers are often subjected to the same pressures of work intensification in modern work as temporary workers. One of the reasons for this is increased competition between units within client companies themselves, brought on in part by the upgrading of external companies in the value chain. Contractors may also be large and stable companies where the employees enjoy significant employment security, making the contractor workers effectively a part of the core operations of its own company while, simultaneously, in the periphery with respect to the work organization in the client company's facilities.

Safety management

Worker participation is considered to be a key to effective and efficient control of workplace hazards and reduction of work-related injuries (Gunningham, 2008; Johnstone *et al.*, 2005). The position and status (perceived or actual) of contractors on multi-employer worksites in general, and subcontracting chains in particular, may however affect the workers' motivation and ability to participate in activities connected to safety. Lingard and Holmes (2001) studied risk control in the Australian construction industry and found that the employees of small companies in the lower levels of subcontracting chains had little or no say in decisions made regarding their own work environment. This perceived powerlessness had led to a deep-seated resignation and a general acceptance of work-related risks as something unavoidable. Relatedly, Mayhew *et al.* (1997) found that risks were considered a natural part of construction work and that measures taken to limit the risk of injury overwhelmingly focused on the individual workers. Safety was, in other words, not upheld through systematic safety management or by removing the source of the hazard itself, indicating that contractor employees' experience of being in the midst of significant work-related risks had become normalized. Wadick (2010) also showed that contractor employees in the construction industry viewed hazards and risks as predictable and acceptable within their own trade, but that the interrelationships between different companies at the worksite may pose safety problems. The industry as such was seen as fostering a culture of independence at the expense of cooperation and consideration of others on the multi-employer worksites. Focusing on the Norwegian oil industry, Dahl (2013) found that contractor workers frequently were unwilling or unable to familiarize

themselves with the documentation in the safety management system due to disinterest and/or time constraints. An important factor was that the contractors moved from worksite to worksite, all with their own set of rules, which made it difficult to fully embrace the different safety management systems. Another study in the Norwegian oil and gas industry by Hovden *et al.* (2008) showed that this 'nomadic' tendency among small contractors in particular meant that the workers received little support from the safety representatives on-site. Taking the perspective of a main contractor in the Australasian construction industry, Biggs *et al.* (2013) found that some safety leaders viewed the transient nature of external companies' involvement in projects (e.g. through subcontracting) as making management more difficult and that this increased the general risk level at the worksites.

Based on a literature review and empirical study of four different industries in Australia (construction, transport, hospitality, and childcare), Mayhew *et al.* (1997) proposed a typology of socio-structural factors influencing contractors, focusing on:

- economic pressure;
- inadequate regulatory control;
- disorganization effects;
- and loss of collective bargaining power.

Economic pressure and priorities were seen as making it less likely for contractors on both an individual and organizational level to engage in matters related to safety, such as systematically assessing risks in the work environment or implementing safety training programs. Subcontracting may also undermine regulatory control in connection to health and safety in general due to the complex nature of multi-employer arrangements, leading to inadequate oversight from government health and safety inspectors (see Quinlan *et al.*, 2009). Regarding disorganization effects, it was concluded that pyramid (i.e. multi-tiered) subcontracting involving companies in vertical and horizontal work arrangements may result in a number of complicating factors. Among these are role ambiguity, undermined safety systems, and unclear relationships between companies working in the same area. Pyramid subcontracting was also seen as directly affecting contractor workers' ability to organize and communicate with each other, and thus limiting the possibility of taking collective action in matters connected to safety. Quinlan and Bohle (2008), in their literature review of outsourcing and home-based work mentioned above, concluded that these overall socio-structural factors warrant further consideration when it comes to understanding the mechanisms by which outsourcing affects health—including occupational injuries. Similarly, Nenonen and Vasara (2013) listed a number of complicating

factors in relation to safety management in the manufacturing industry such as ineffective and insufficient information sharing, lack of common procedures, substandard coordination of safety measures, unclear management control and responsibilities, and cultural and language barriers.

The matter of cultural and language barriers to contractors' involvement in safety-related activities was also the focus of Schubert and Dijskstra's (2009) study of the process industry in the Netherlands. Five areas in connection to contractors were identified as problematic:

- communication regarding work permits, instructions, and risk;
- level of education among personnel from other countries;
- cultural differences, leading to deviations from on-site regulations and safety norms;
- the contractor workers' specific employment situation, leading to under-reporting of incidences and overtime work;
- and cooperation between principals (i.e. client companies) and contractors, where principals often had reservations regarding contractors bringing in companies and personnel from other countries.

The increased presence of multi-national contractors in the construction industry was studied by Bust *et al.* (2008), showing similar problems. The main focus of the study was on the process of converting health and safety systems to accommodate a multi-cultural workforce, with the aim of initiating greater worker participation. It was concluded that it is important to identify which audio-visual representations are perceived as meaningful and that this, to some extent, can be achieved by investigating what cultural narratives are used by workers to inform their understanding of health and safety-related matters. Seen from a wider perspective, Starren *et al.* (2013) remarked that the general effects of national culture on safety behaviour in multi-cultural work settings is also largely unexplored in research.

The practice of having specific safety advisors or similar roles on-site to coordinate and safeguard contractors was explored by Cameron *et al.* (2013). The study showed that contractors hiring external safety consultants had an Accident Incidence Rate (AIR) almost three times higher than those that employed internal safety personnel. Companies with internal safety advisors, who had the authority to give direct orders in matters related to safety, also had a lower AIR than those whose consultants merely gave advice. A conclusion was drawn that employing at least one internal safety advisor is better than relying on an external safety consultant, and that the internal advisor should report directly to the contractor senior management but still, at the same time, have delegated authority over safety issues. Jacobsson (2011) studied the role and function of

liaisons for the coordination of projects, focusing on the communication sub-processes in multi-employer settings. The results showed that, just as contractor safety advisors, project liaisons also played important roles in coordinating activities and unexpected situations, translating and reducing information and, ultimately, bringing the contractors' experience of the work situation into light. All in all, project liaisons may be seen as crucial in reducing the uncertainty that contractors and their workforces sometimes experience being in the periphery of a network.

Through cases studies in the US mining industry, Calizaya *et al.* (2008) provided an additional number of steps that can be taken to facilitate the effective coordination of work tasks, for instance, ensuring that contractors are familiar with the client's standard work procedures and training them in facility-specific hazards. The responsibility for underlining existing conditions and possible work-related risks on multi-employer worksites was, consequently, placed on the client companies. A similar perspective was taken by Hui *et al.* (2008), focusing on coordination in complex projects. In order to reduce confusion and mistakes in the coordination of multiple outsourcing partners, high owner dominance over project activities was seen as important. The high interdependence between the parties involved would benefit from a clear set of established routines. Moderate or low owner dominance, where responsibility is divided between client and contractors, may lead to an ineffective patchwork of rules from parties having differing work practices, cultures and goals. This may ultimately lead to coordination problems and generally unsafe working conditions. Votano and Sunindijo (2014) further underlined that client companies' active and 'hands-on' support in safety-related matters are important considering the highly competitive nature of contract work. As mentioned above, economic pressure and time constraints often make it difficult or less likely for contractors to prioritize safety. As a remedy, client companies participating in site-based safety programs, reviewing and analyzing safety data, and performing regular checks on equipment and the plant, may strengthen overall safety performance.

However, in a literature review of employers' and clients' motivation to establish voluntary preventive management arrangements in supply chains (e.g. subcontracting chains), Walters and James (2011) found that market-based business motivations are rarely enough to encourage the implementation of such strategies. A conclusion was drawn that policy makers need to be more active in encouraging the implementation of proactive and preventive measures, rather than simply relying on the voluntary actions on the part of the dominant company or companies in a given supply chain.

Besides the above mentioned more or less voluntary utilization of functions and roles, all industries have specific laws and regulations that guide the development

and implementation of safety management. Loosemore and Andonakis (2007) studied the effects of the occupational health and safety regulation in the Australian construction industry, where a shift in responsibility towards main contractors and contractors was made in 2001 with regards to overall health and safety management. The main barriers for complying with the new regulation among affected parties were implementation costs, language and educational barriers, and a fear of change among small contractors in subcontracting chains. A number of remedies were suggested, such as integrating health and safety training into broader skills training, involving a third party responsible for the training, and subsidizing the costs of training. The importance of safety training was also explicated by Rebitzer (1995), arguing that client companies generally have better safety training programs than contractors, and should therefore take more responsibility for the continuous training of temporary personnel entering the premises.

Safety culture and safety climate

Clarke (2003) studied the implications of the trend towards contracting and changing employment arrangements, concluding that it will be difficult to integrate contractor workers into an existing safety culture. One particularly problematic aspect may be getting the temporary workforce to internalize the values of the client company. Likewise, in a study in the US construction industry, Molenaar *et al.* (2009) found that frequent use of contractors could adversely affect organizational safety, with a view on safety culture as something that tends to develop within more or less homogenous workforces staying together over a number of years. A positive safety culture, then, was seen as partly dependent on the development of stable relations between permanent employees, a consistency that may be disrupted by subcontracting and the characteristics and internal workings of multi-employer worksites. The importance of establishing long-term relationships with contractors was underscored, as a way of encouraging the development of a durable safety culture.

In a survey of 41 safety leaders in various Australasian construction companies, Biggs *et al.* (2013) found that the matter of having to deal with cultural integration and competency gaps in relation to contractors is a significant barrier to the improvement of an overall safety culture. In assessing the relationship between in-house personnel and contractor employees in offshore drilling, Fuller and Vassie (2001) showed that partnership arrangements within recognized and well-implemented joint safety management systems may be important in order to align different safety climates and safety cultures in multi-employer work settings. The added complexity of having different companies managing different safety regimes in the same work environment was also explored by Bahn (2013) in the

Australian mining industry, showing the benefits of having one safety system for all personnel as a 'tool' in the development of a joint safety culture. The case study indicated that a move from hiring contractors to only having in-house personnel may increase safety at the worksite through the use of only one safety regime for all the workers.

Few studies on safety culture in high-risk industries have focused directly on safety culture among contractors. An exception is an ethnographic study in the Australian construction industry by Wadick (2010), where the forging of contractors' safety cultures was conceptualized as consisting of matters pertaining to general workplace culture as well as seven other interacting elements: 1- the construction site, 2- work methods, 3- the subcontracting system, 4- people/ construction personnel, 5- equipment and materials, 6- training, and 7- occupational health and safety knowledge and legislation. It was concluded that the contractors in the study strived for safety, but that it was often compromised by aspects such as the nature of the work being performed, economic pressure and time constraints, the relations between the trades, and the power and influence that the main contractor exerted. Connected to this was a masculine culture of risk-taking and toughness that historically has been a part of the industry. Regarding the power perspective and the inherently hierarchical nature of contracting arrangements, Rosness *et al.* (2012: 1967) raised a similar point in a study of the Norwegian oil industry, stating that: "the safety work of contractors and subcontractors may be constrained or facilitated by environmental conditions that are created and maintained by the operator or co-created by the operator and the contractor or subcontractor".

These environmental conditions, which could involve everything from the layout of a facility to assumptions and norms ingrained in the organizational culture, were thus seen as enhancing and/or restricting the ability of contractors in general to keep risks under control in industrial work settings. Rosness *et al.* (2012) further underlined the importance of taking a holistic approach when studying environmental conditions affecting contractors, where the actions of one party in safety-related matters are significantly dependent on the actions of other parties in the network.

Same as with safety culture, there are few published studies on the safety climates of contractors. Another exception is a survey by Lingard *et al.* (2010), focusing on contractor workers in the Australian construction industry. By utilizing a multi-level safety climate model, it was shown that the perceptions that contractor workers develop of the main contractors' safety climate(s) may be considered a possible mechanism of influence that a given main contractor, in turn, can focus on in order to encourage more stable safety, as well as health, performance among these groups.

Conclusion

Most of the research on safety on multi-employer worksites has been directed towards the construction sector, which is reasonable considering that contracting arrangements have been a long-standing feature of that industry. Studies on the conditions in industries such as mining and petroleum production have begun to surface but, overall, these are still to be considered as developing empirical research areas. The fact that the term 'contractor' is used in a variety of ways in research, on occasion being a catch-all word for all types of contractors (main contractors, subcontractors, contractor employees, etc.), also points to a need for conceptual clarification and more precise terminology. Based on the accumulated literature, however, a number of key concepts and terms may be discerned that have been the subject of interest among researchers. These are neither distinct nor separated from each other and overlap in various ways, indicating the complexity inherent in multi-employer arrangements and the multitude of perspectives that can be taken on safety. Despite this, it may be useful to tentatively group the terms and concepts into three broad categories: 1- contract work characteristics, 2- structural/ organizational factors and conditions, 3- cultural conditions (Table 3).

TABLE 3

Categories and key terms and concepts

Category	Key terms and concepts	
Contract work characteristics	• Economic pressure • Employment insecurity • Insufficient knowledge and competence • Low autonomy and task demand • Normalization of risk • Nomadic tendencies • Powerlessness and resignation	• 'Second-class citizens' • Time constraints • Transient and transactional relations • Temporary and/or peripheral work • Unfamiliarity with work environment
Structural/ organizational factors and conditions	• Communication barriers • Contactors in dependent positions • Complex work and safety coordination • Core-periphery structure • Disorganization effects • Division (and diffusion) of responsibility • Fragmentation of production processes and work tasks	• Hierarchies and power asymmetries • Inadequate regulatory control • Less unionization/loss of collective bargaining power • Pyramid subcontracting • Unstable social relations
Cultural conditions	• Cultural integration difficulties • Cultures of independence • Differing norms and values	• Homogeneous vs. heterogeneous workforces • Macho-masculine work culture

These broad categories, however, do not necessarily make explicit the actual mechanisms and conditions affecting health in terms of occupational injuries or overall safety on multi-employer worksites. To date, one of the most extensive literature reviews on the general subject of health and safety in relation to outsourcing has been conducted by Quinlan and Bohle (2008). Similar to a previous study by Mayhew *et al.* (1997), the authors concluded that a number of specific factors deserve further investigation: 1- economic and reward pressures, 2- disorganization, and 3- insufficient regulatory protection. Although the present literature review focused specifically on multi-employer worksites, these three factors could seamlessly be used to subsume much of the key terms and concepts assembled in table 3 to explicate the actual mechanisms of influence. But Quinlan and Bohle (2008) also underlined that the research up to that point rarely considered that contractors, and especially smaller firms, oftentimes are positioned at the far-end of a subcontracting chain and, consequently, in a dependent position *vis-à-vis* their main contractor or a client company. There are clear exceptions, such as the study by Collinson (1999) in the North Sea oil industry, however; overall, a power perspective in relation to work organization and safety had largely not been applied.

This latter point is also corroborated in this literature review of multi-employer worksites in high-risk industries specifically, i.e. that there is still a need for further investigation on the nature of these underlying hierarchical conditions—similar to the studies conducted by Lingard and Holmes (2001) in construction, Rosness *et al.* (2012) in petroleum and Lamare *et al.* (2015) in mining. For example, a theme that may be further explored is how the application of safety laws and regulations affects, and is affected by, the norms and practices that develop in asymmetrical power relations in multi-employer arrangements. Some actors in these networks, such as the client companies outsourcing the work, are clearly often in a position to dictate the actual terms and conditions of how work is going to be carried out, as well as being in control of the setting itself in which the work is taking place. The possible effect this has on the ability and willingness of contractors to adhere to safety laws and regulations that, in themselves, may place demands contrary to those of the 'reality' of the work being performed (e.g. production pressure), deserve further study. Closely related is the matter of how responsibility for safety is conceptualized, negotiated and acted upon on multi-employer worksites in relation to the means available (e.g. the functionality, or lack, of safety management) and the regulatory demands and power relations in play. In order to get a clearer view of how the notion of responsibility is formed under these circumstances, studies focusing simultaneously on external influences (e.g. safety laws and government control and oversight) and internal work organization and emerging formal and informal safety practices on multi-employer worksites (including subcontracting chains) are required. An adjacent

theme is the ambition of client companies to implement voluntary safety programs under the banner of 'Safety First' or variations thereof, and the nature and effectiveness of these programs on multi-employer worksites. This is in line with the general points made by Walters and James (2011) and Votano and Sunindijo (2014) that dominant parties in supply/subcontracting chains tend to be in a position to implement changes to improve overall standards of working conditions.

Finally, besides the more or less inter-organizational perspectives highlighted above in terms of the structure and dynamics of multi-employer worksites, one significant omission in the literature on high-risk industries concerns the consequences of the blurring of organizational boundaries in these networks. Although this development has been investigated in various industries (e.g. Marchington *et al.*, 2005), there is a scarcity of research articles on how these emerging hybrid organizations, where the boundaries between the companies involved have become blurred due to extensive outsourcing and long-term contracts, may have affected workplace safety specifically—including underlying issues such as work group dynamics and division of safety roles and responsibilities. We would argue that this development, in particular, could be a fruitful avenue for future research when it comes to furthering the understanding of safety in multi-employer arrangements in high-risk industries.

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SUMMARY

Safety and Multi-employer Worksites in High-risk Industries: An Overview

This paper focuses on safety on multi-employer worksites in high-risk industries. Relevant industries are those that utilize flexible labour arrangements and specialization, such as construction, mining and petroleum production, and that traditionally have been high-risk due to hazards in the physical work environment and the occurrence of unsafe work processes and practices. These industries also share common characteristics in matters of overall work environments, multi-employer worksites (including subcontracting chains), as well as tasks performed by contractors, making it relevant to explore and clarify the situation regarding the safety of the affected groups. A comprehensive review is performed of 43 peer-reviewed research articles published up until early 2015, with a main focus on international studies covering safety issues on multi-employer worksites in construction and industrial work settings such as mining, petroleum production and manufacturing.

The results show that previous research has focused on a number of key issues that may be divided into three broad categories: 1- contract work characteristics; 2- structural/organizational factors and conditions; 3- cultural conditions. Much of the focus is on structure and organization, for example, how multi-employer arrangements can lead to breakdowns in communication and overall disorganization effects in relation to safety. There is, however, a need for further studies on the nature of these structural and organizational factors and conditions, such as focused studies on the consequences of power asymmetry for the ability of contractors to adhere to safety laws and regulations. Furthermore, we argue that the development towards blurred organizational boundaries in these networks due to extensive outsourcing and long-term contracts may be a worthwhile avenue for future research into safety on multi-employer worksites.

KEYWORDS: safety, multi-employer worksites, outsourcing, subcontracting, contractors.

RÉSUMÉ

Sécurité au travail et lieux de travail multi-employeurs dans les industries à hauts risques : une vue d'ensemble

Cet article se concentre sur les mesures de sécurité dans les chantiers multi-employeurs d'industries à hauts risques. Les industries concernées sont celles qui font appel à l'organisation du travail flexible et à la spécialisation, telles que la construction, l'activité minière et l'industrie pétrolière, et qui sont traditionnellement reconnues comme comportant des risques élevés à la santé à cause des dangers inhérents à l'environnement physique du travail et à l'existence de pratiques

et de processus de travail non sécuritaires. Ces industries ont aussi en commun certaines caractéristiques en matière d'environnement de travail général dans des milieux de travail multi-employeurs (incluant des chaînes de sous-contractants), de même qu'en matière d'activités exercées par les entrepreneurs, justifiant ainsi le besoin d'explorer et de clarifier la situation en regard de la sécurité au travail des groupes affectés. Pour ce faire, nous avons mené un examen approfondi de 43 articles de recherches évalués par des pairs et publiés jusqu'au début avril 2015, avec une attention particulière envers les études internationales couvrant les questions de sécurité au travail dans des milieux multi-employeurs dans la construction et dans des secteurs industriels, telles l'activité minière, la production pétrolière et l'activité manufacturière.

Les résultats indiquent que ces recherches ont jusqu'ici identifié un certain nombre d'enjeux-clés qui peuvent être regroupés en trois grandes catégories : 1- les caractéristiques du contrat de travail; 2- les conditions et les facteurs structurels et organisationnels; 3- les conditions culturelles. L'attention principale porte sur les dimensions structurelles et organisationnelles, à savoir comment les dispositions multi-employeurs peuvent conduire à des ruptures dans la communication et à des effets de désorganisation générale en matière de sécurité au travail. Il y a, également, un besoin de poursuivre les études sur la nature de ces facteurs et de ces conditions structurelles et organisationnelles, notamment la réalisation d'études portant sur les conséquences de l'asymétrie de pouvoir et sur la capacité des entrepreneurs d'adhérer aux règlementations et aux lois en matière de sécurité au travail. De plus, nous soutenons que la croissance de frontières organisationnelles floues dans ces réseaux, en raison de l'existence d'une importante sous-traitance et de contrats à long terme, devrait se révéler une avenue prometteuse pour les futures recherches sur la sécurité au travail dans des milieux multi-employeurs.

MOTS-CLÉS : sécurité au travail, lieux de travail multi-employeurs, impartition, sous-traitance, entrepreneur.

RESUMEN

Seguridad ocupacional y lugares de trabajo multi-patronales en las industrias de alto riesgo: una visión general

Este artículo focaliza las medidas de seguridad en los empleos multi-patronales de las industrias a alto riesgo. Se trata de las industrias que utilizan la organización de trabajo flexible y la especialización, tales como la construcción, la actividad minera y la producción petrolera, tradicionalmente reconocidas como actividades de alto riesgo debido a los peligros inherentes al entorno físico del trabajo y a la existencia de prácticas y procesos de trabajo inseguros. Estas industrias comparten también ciertas características comunes en materia de ambiente general de trabajo, los empleos multi-patronales (incluyendo las cadenas de subcontratación) así como las actividades ejercidas por los contratistas, confirmando así la pertinencia

de explorar y esclarecer la situación respecto a la seguridad ocupacional de los grupos afectados. Para ello, se llevó a cabo un estudio exhaustivo de 43 artículos científicos publicados hasta principios de 2015, con un énfasis particular en los estudios internacionales que cubren las cuestiones de seguridad ocupacional en los empleos multi-patronales del sector de la construcción, así como de las industrias minera, petrolera y manufacturera.

Los resultados muestran que las investigaciones anteriores se han centrado en una serie de cuestiones claves que pueden ser reagrupados en tres grandes categorías: 1) las características del contrato de trabajo; 2) las condiciones y factores estructurales y organizacionales; 3) las condiciones culturales. La atención principal es puesta en las dimensiones estructurales y organizaciones, así, por ejemplo, cómo los acuerdos entre múltiples empleadores pueden conducir a rupturas en la comunicación y provocar efectos de desorganización general en materia de seguridad. Se constata, sin embargo, la necesidad de continuar los estudios sobre la naturaleza de dichos factores y las condiciones estructurales y organizacionales, y de realizar estudios sobre las consecuencias de la asimetría de poder y la capacidad de los contratistas de adherir a las leyes y reglamentaciones en materia de seguridad ocupacional. Es más, sostenemos que el crecimiento de fronteras organizacionales nebulosas en esas redes, debido a la amplitud de impartición externa y de los contratos a largo tiempo, puede constituir una vía prometedora para futuras investigaciones sobre la seguridad ocupacional en los lugares de trabajo multi-patronales.

PALABRAS CLAVES: seguridad ocupacional, lugares de trabajo multi-empleadores, impartición, sub-contratación, contratistas.