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Safety at the frontline: The social negotiation of work and safety at the principal contractor-subcontractor interface

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Abstract

The research investigated the influence of the social context on work practices and safety at the principal contractor-subcontractor interface. Previous research has acknowledged that the social interactions among supervisors and workers shape safety implementation on worksites. However a detailed examination of the nature and impact of these social interactions has been missing. An ethnographic method was deployed in which a researcher spent approximately 100 hours attending four construction sites over a six month period. This deep embedded research method enabled the nature and impact of social interactions to be explored. Organised safety walks and informal ‘walkarounds’ were attended, during which interactions were observed and conversations were held with project participants, including foremen, professional health and safety advisors, supervisors and workers. Field notes and comments were subjected to thematic content analysis. Different understandings of safety were apparent, with key differences emerging in relation to the role attributed to the principal contractors’ site safety rules. The social ecosystem at the four sites was also embedded within broader construction industry practices, in particular competitive tendering and price-based selection. The results reveal limitations inherent in traditional technical approaches to understanding safety in the construction site environment, as these approaches tend to ignore the social and power relations at play. The results reveal that safety at the principal contractor-subcontractor interface is better understood as an emergent property of a complex ecosystem of social relationships and interactions.

Keywords

Principal contractor, subcontractor, safety, rules, supervisor

Ethnographic snapshot

David was standing on the concrete floor slabs, in what would eventually be ground level. A nearby worker was bending steel rebar, and a tube appeared from below, where the plumbers, sprinkler fitters, and electricians were located. David observed a concrete floor slab (approximately 300mm by 6 m) dangling in the air overhead as the crane operator moved it across site and into place. To the right a team of around ten steel fixers were putting mesh into place in preparation for a concrete pour in the morning. To the left, a health and safety advisor was talking with a worker about how to improve access in the area. The site was busy. The suspended concrete slab was placed on top of another slab. Its final destination was not ready yet, so it was being stored. The site manager noticed that the slab had elevated ‘ground level’ by 300mm, and the handrail was now at hip height no longer providing fall protection. In a matter of minutes and, without intention, something that was safe had become unsafe.

Introduction

This snapshot illustrates the fluidity of the construction site environment and the need for supervisors and workers to ‘think on their feet.’ The management of safety in construction is often described as a rationalist and technical activity, in which risks can easily be identified, quantified and controlled (Zou et al, 2014; Sherratt, 2016; Oswald et al., 2018). The snapshot reveals the inherent unpredictability and emergent nature of safety in the site environment

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and the type of everyday circumstances that contractors and sub-contractors respond to on a daily basis.

In this paper we describe and discuss the results of an ethnographic study of the principal contractor-subcontractor interface at four construction worksites. Our objectives in conducting this research were to:

- explore the way that actors at the principal contractor-subcontractor interface understand and respond to safety as it happens, and
- shed light on the way that the worksite social context (manifest in the relationships and interactions between actors working for the principal contractor and subcontractor) shapes work practices and safety at the construction worksite.

The impact of subcontracting on construction safety

The construction industry performs poorly in workplace health and safety and is identified as a priority industry in the *Australian Work Health and Safety Strategy 2012-2022*. The Strategy also emphasises the need to integrate and embed health and safety management processes across supply chains (Safe Work Australia, 2012).

The construction industry is characterised by the use of long (and often complicated) supply chains, with the majority of site-based construction work performed by subcontractors (Dubois and Gadde, 2000; Hartemann and Caerteling, 2010). Subcontracting is widely reported to create challenges for the management of workplace safety (Arditi and Chotibhongs, 2005; Debrah and Ofori, 2001). Loosemore and Andonakis (2007) argue that, although trade subcontractors make up the bulk of the Australian construction industry's workforce and often account for over 90 per cent of a project's value, they "lack the resources, culture and skills" to manage workplace safety risks effectively (p.580). Wadick (2010) suggests that poor communication between trades and ineffective consultation between workers and managers increase the safety risks associated with subcontracting in construction projects. Further, 'payment-by-results' arrangements under which subcontractors are typically engaged can encourage corner-cutting with regard to workplace safety (Mayhew et al. 1997; Mayhew et al. 1997).

Contrasting perspectives on workplace safety

Traditionally, workplace safety has been viewed as an objective property of a technical system that can be measured through formal risk quantification and managed through the specification of risk control measures (Gherardi and Nicolini, 2000a). In this view of safety, workers are regarded as having limited competence and a high propensity for error. As a result, it is assumed that workers' behaviour needs to be controlled through the establishment of prescriptive action rules (Dekker, 2003). These rules are context-free, developed by technical experts and enforced by management (Hale and Borys, 2013). Further, safety rules are expected to cover all eventualities and are consequently applied inflexibly, irrespective of context (Dekker, 2003). Workers who break the rules are characterised as being either careless or deviant (Von der Heyde et al., 2015).

However, Dekker (2005) argues this explanation of rule-breaking behaviour ignores the social and technological complexity of workplaces, in which everyday trade-offs are made as workers pursue multiple (often competing) goals. Thus, what seems like a clear case of deviant behaviour from outside the organisation (usually with the benefit of hindsight) can look like a perfectly reasonable action to a worker trying to do their job (Dekker, 2005). The situation is further complicated in the construction site environment because workers juggle

multiple demands emanating from their employing organisations (often subcontractors) with those of the principal contractor. These demands are not always aligned, increasing goal conflict and the need to make daily trade-offs (Briscoe & Dainty, 2005). Indeed, sometimes workers prefer to work ‘close to the edge’ in relation to safety to demonstrate their skill or mastery of their tasks (see, for example, Ozmec et al., 2015).

An alternative and arguably more nuanced view of safety positions it as “situated, negotiated, generated, and transplanted” in the historical, socio-material, and cultural context in which work occurs (Turner and Gray, 2009, p. 1260). This view recognises that safety is much more than a set of rules, that it means different things to different people and that it is complicated, changeable and hard to measure (Sherratt, 2016). Consistent with this view, a distinction is made between rules (explicit prescriptions) and routines (their behavioural manifestation) (Bruns, 2009). Rules are abstract, often developed by technical experts remote from the worksite and imposed from the top down (Knudson, 2009), whereas routines are collectively learned through social interactions and shaped by the interests and objectives of actors in a workplace (Bruns, 2009). Thus, Gherardi and Nicolini (2000a) describe how workers are socialised into ‘communities of practice’ through which safety is learned in an ongoing dialogue that is inevitably influenced by the power distribution between the communities of practice present in a given environment. The work practices of novice construction workers have similarly been described as “the final outcome of a collective construction process, ‘a doing,’ which involves people, technologies and textual and symbolic forms assembled within a system of social relations” (Gherardi & Nicolini, 2002, p.192).

The prevalence (perhaps inevitability) of rule-breaking in work contexts highlights the limitations associated with adopting the traditional prescriptive approach to understanding work practices and safety (see, Alper and Karsh, 2009). This is further illustrated by a study of civil construction contractors conducted by McDermott and Hayes (2018). The civil contractors were subcontracted at the lowest level of a length supply chain to undertake works in proximity to buried infrastructure as part of a large national infrastructure construction project within Australia. The civil contractors were selected on price and paid by square meterage of work completed. McDermott and Hayes (2018) observe that financial and safety risk were pushed down to the lowest level of a long supply chain (see also Sherratt, 2016). The head contractor had established a set of detailed safety procedures and it was assumed that these procedures were followed and therefore safety risks were being managed effectively. However, in reality, schedule pressures and the payment-by-results system made it impossible for subcontractors to follow the rules and remain profitable. Consequently, workers sometimes omitted important safety procedures (for example, omitting ‘dial-before-you-dig’ checks or non-destructive pot-holing before excavating). The potential consequences of these rule violations for worker and public safety are very serious (McDermott and Hayes, 2018). The example provided by McDermott and Hayes (2018) highlight the complex nature of safety and the gap that can exist between procedure and worksite practices (Lofquist et al., 2017).

The principal contractor-subcontractor interface

The way in which safety is socially constructed and subsequently enacted at the principal contractor-subcontractor interface is the subject of this paper. The principal contractor-subcontractor interface is defined as the point of intersection or boundary between the organisation, systems and personnel engaged by the principal contractor and those of the subcontractors they engage to deliver components of the construction work. Managing the boundary between horizontal elements (e.g. subcontractors) has been identified as a critical

factor in project success (Fellows and Liu, 2012). Previous research has shown that subcontracting arrangements are detrimental to workers' safety (Mayhew et al. 1997; Mayhew & Quinlan 1997). An ethnographic study of the Australian construction industry revealed that principal contractor personnel focus more on getting the job done, than communicating and consulting with subcontractor personnel, resolving conflicts and ensuring safe work practices (Wadick, 2010).

However, principal contractors have legal responsibilities for the provision of safe and healthy workplaces and systems of work in construction projects. In all Australian jurisdictions, principal contractors also have additional responsibilities for the planning and coordination of the work of multiple subcontractors to ensure that workplace health and safety risks are effectively managed. Thus, management at the principal contractor-subcontractor interface is an important issue for legal compliance and safety performance.

While many studies have identified subcontracting practices as having the potential to negatively impact workplace safety, relatively few studies have examined factors that reduce safety risks associated with the management of subcontractors. Manu et al. (2013) investigated the formal management activities used by UK-based principal contractors to manage subcontractors' safety, identifying activities such as undertaking competence assessment, ensuring the preparation of risk assessments and conducting safety training and inductions. The research presented in this paper adds to this understanding of formal subcontractor management activities by considering the way in which informal, social processes at the principal contractor-subcontractor interface impact workers' safety practices.

The importance of site supervision

Site-based supervisors plan, organise and facilitate daily work activities in construction projects and have a strong influence on the way work is performed, including in relation to workplace safety (Hardison et al. 2014). Supervisors operate primarily at the principal contractor-subcontractor interface and their role is critical in shaping work practices and safety. For example, in a study of the London Olympic construction program, Finneran et al. (2012) identified supervisors' capabilities and competencies as a critical factor driving project safety performance. In Denmark, Jeschke et al. (2017) found that training construction supervisors in communication behaviours changed the way they interacted with workers and produced higher levels of safety-related cooperation and performance among subcontractor workers.

The influence that supervisors have on site-based safety practices is also believed to be significantly greater than that of senior managers due mainly to the frequency of supervisors' interactions with workers (Therkelsen and Fiebich, 2004). While workers rarely interact with senior managers, they receive daily instructions and performance feedback from their supervisors (Zohar, 2000). Fugas et al. (2011) also describe how supervisor-worker interactions produce social norms that determine the safety-related behaviours that are 'expected' of workgroup members.

Supervision in conditions of subcontracting

Although subcontractors are engaged to perform physical construction work, in most cases the principal contractor provides a foreman to oversee subcontractors' operations at a worksite (Sherratt, 2016). This foreman supervisory role is additional to the role of the supervisors who are directly employed by individual subcontractors to manage the work of

their own workgroups. Previous research suggests the interaction between these two levels of supervision has the potential to shape safety practices in the workplace. For example, in a study conducted in the Australian construction industry, Lingard et al. (2010) report the safety climate of a subcontracted workgroup was most strongly influenced by the emphasis placed on safety by the subcontractor supervisor. However, subcontractor supervisors' safety-related practices were also significantly shaped by the extent to which they perceive the principal contractor's foreman to be concerned about safety (Lingard et al. 2010). The engagement of a foreman whose role is to oversee and coordinate the work of subcontractors has also been identified as a strategy adopted by principal contractors to reduce the negative impact of subcontracting on safety performance in the UK construction industry (Manu et al. 2013).

Research methods

Data collection

Previous ethnographic studies have been able to complement positivist approaches in construction management research (see, for example, Borys, 2012; Löwstedt, 2015; Oswald et al., 2019). Pink et al., (2013) explain that ethnographic research can provide the insight that is necessary for understanding and developing theory about construction practice. Phelps and Horman (2010) similarly identify a critical need for theory-building methodologies in construction, recommending the use of ethnography. Hence, an ethnographic approach was taken in this research to explore and better understand safety practices at the frontline of construction work.

Ethnography describes the study of a specific group of people in their natural setting (Phelps & Horman, 2010). Proponents of ethnography argue that the validity of ethnographic research is a major strength because: (i) the relatively long data collection period allows for extended analysis, refinement and interpretation of data, and (ii) data collection occurs in a natural rather than a contrived, setting (LeCompte & Goetz, 1982).

In this case, the natural settings were four construction projects in the centre of a large Australian city. The four projects were of a similar scale and nature. They all involved the regeneration of urban areas to create mixed use developments incorporating high rise commercial and apartment buildings and landscaped gardens and recreational spaces. Access to data is the single most practical concern in ethnographic research (Pole & Morrison, 2003). The four projects were delivered by a single principal contractor who granted relatively unrestricted access to the research team for the purposes of data collection. Thus, the sites were purposefully selected on the basis of their accessibility.

The construction work at each project was almost entirely performed by subcontracted workgroups and a wide range of trade-based workgroups were present across the projects. These included steel fixers, concretors, crane operators, painters, carpenters and tilers. Observed workgroups ranged in size from two (a crane operator and supervisor) to twenty workers. The length of time each subcontracted workgroup remained at a site was dependent on the tasks being carried out and the stage of construction. At the front-line, the principal contractor's site manager and foremen coordinated and managed the work of the subcontracted workgroups, which consisted of a supervisor, leading hand(s) and construction workers.

The researcher used organised safety walks as a way to access all areas of the site. The organised safety walks were weekly walks that anyone engaged at the construction project

could attend. These walks were organised by the health and safety team. The researcher had a 'gatekeeper' at each of the projects who attended all of these walks. This provided an opportunity for the researcher to be introduced (by the gatekeeper) to other supervisors, workers and managers who attended the walk. Thus, a random snowball-sampling approach was used whereby, each week, the researcher was able to talk to different people engaged at each of the projects. Further, the numbers of people the researcher interacted with at each project grew as the research progressed and the researcher became familiar with people at each site. As the researcher gained the trust of site-based personnel through attendance of these walks, he was then introduced to other members of the participants' work groups, further extending his 'reach' and providing indepth insight into health and safety practices at each site.

The walks always began at the top of the building under construction, and each floor was examined by those who participated until they reached the bottom floor. Thus, the walks provided an ideal opportunity to observe and listen to conversations about health and safety practices and challenges throughout each site. Due to their structure (i.e. from top to bottom of the buildings under construction), walks on sites in the early stages were shorter in length (approximately one hour), while walks conducted at later stages of construction could take more than three hours. The researcher also undertook more informal safety 'walkarounds' and shadowing health and safety and supervisory personnel both from the principal contractor and subcontractor organisations over a six month period. The shadowing of individuals meant that their interactions could be observed and discussed in informal conversations. In these informal conversations, the researcher would ask open-ended questions relevant to the research aims. Example questions included: "how is subcontractor safety managed and maintained at this worksite" and "how are safety issues resolved if subcontractors are not compliant with [principal contractor] requirements?"

An observational approach to understanding the role played by social relations in shaping safety practices was selected because these practices: (i) are emergent and dynamic, (ii) involve multi-actor interactions, (iii) may deviate from documented safety procedures, and (iv) may be difficult for actors to verbalise (see, also, Bruns, 2009). Long duration ethnographic fieldwork is often not viable, particularly in the temporary and dynamic construction site environment. This has led to the development of alternative ethnographic approaches, such as the design of shorter duration, multi-sited studies to explore social and behavioural phenomena in construction (see, for example, Tutt et al., 2013). Approximately 100 hours of observational data were collected during this study. Apart from following organized safety walks (described previously), the data collection was not structured or driven by a particular data collection tool, matrix or framework. Instead, a more typical ethnographic approach was adopted, in which the researcher remained open-minded and focused observation on any health and safety-relevant conversations, issues or events occurring at the time of the site visit.

A key advantage of the ethnographic approach was that the researcher could observe and discuss interactions between principal contractor and subcontractor personnel as these happened. Potential issues of recall and social desirability bias associated with retrospective data collection were reduced. Further, participants could more readily explain their interactions and practices because these were explored at the time of observation and in the workplace context. Before beginning the site-based observation, the researcher undertook health and safety induction training at all four projects, providing an understanding of the safe work practices prescribed in rules established at each site.

The researcher spent approximately 100 hours of time (in total) at the four sites. Following each observation session initial field notes were taken. These notes were typed onto the researcher's mobile phone. This is less obtrusive than taking notes with pen and paper, which could generate distraction or distrust among participants (Hammersley & Atkinson, 2007), or act as a reminder to people that they are being studied (O'Reilly, 2012). The initial notes were subsequently written up into more extensive field notes as soon as possible after leaving the site. Ethnographic work can account for the uncertainty of social life, provide detail and depth of social action and acknowledge the researcher-researched interaction in the production of social knowledge (see Pole & Morrison, 2003). The observations undertaken in this study captured data on the topic of interest (i.e. social interactions relating to workplace safety) at different times, during different phases of construction, and from different participants, which reduces threats to mis-interpreting subjective data. By spending over 100 hours in the field, the researcher had time to develop a non-threatening perception and establish rapport with participants. This helps those being studied feel relaxed in the presence of the researcher thereby reducing the risk of social reactivity, a situation in which participants change their behaviour because they are aware that they are being studied (Oswald et al. 2014).

Qualitative research often aims for data saturation, rather than achieving a representative sample (see Small, 2009). Data collection proceeded until it was determined that data saturation had been reached. The point of data saturation was determined by applying Guest et al.'s definition as "the point at which no new information or themes are observed in the data" (2006, p59)."

Data analysis

The dataset was rich, collected through face-to-face interactions and the researcher's immersion into the social setting of the construction project. Field notes combined observations of events, records of conversations the researcher heard or participated in, and annotations and commentary the researcher made along the way. Analysing this rich data set consisted of six stages:

- familiarisation with data
- generating initial codes (for example, rule compliance and flexibility, engagement versus enforcement and trade-offs and flexibility)
- searching for common themes
- reviewing themes
- defining and naming themes, and
- producing the final analysis (Braun & Clarke, 2006).

The NVivo software package for analysing qualitative data was used to support the content analysis of the rich dataset collected in the study. Computer aided qualitative analysis has been criticised for adopting a 'code and retrieve' approach, which superimposed a predetermined set of codes and involves a mechanistic coding process resulting in an unimaginatively descriptive analysis (Johnstone, 2006). The NVivo software was designed to support "a weaving of rich primary sources with commentary and discussion and analysis, our evolving discussions and writings that distinguish research from data archiving" (Richards, 1999, p.414). The NVivo software package enabled themes, ideas and interpretations to be linked, providing a 'bird's-eye view' of the pattern and construction of a new understanding of the research problem (Braun & Clarke, 2006).

Results

Our findings suggest that workplace health and safety practices are negotiated through the operation of a multi-layered social ecosystem at the principal contractor-subcontractor interface. This social ecosystem is shown in Figure 1, which shows the relationships observed as being important for work and safety at the principal contractor-subcontractor interface. These were identified in the thematic analysis of data (observations, field notes and documented conversations). The operation of this social ecosystem is described below.

Figure 1: Social ecosystem at the principal contractor-subcontractor interface

Rule compliance and flexibility

Interactions between participants revealed a plurality of views regarding the importance and practicality of following established safety rules 'to the letter.' The principal contractor's foremen were observed to adopt a degree of flexibility with regard to compliance with safety-related rules. One principal contractor foreman explained how he 'trades off' strict enforcement of organisational safety rules with the need to keep subcontractors 'onside' particularly in relation to meeting project production targets: *'It may not be by the book, but we challenge [subcontractors' safety practices] when it is appropriate. There needs to be a balance of keeping good relationships with the subbies and the site rules. You need the subbies onside. It makes life so much easier, 'cause sometimes you need to ask them to stay longer or later to keep on schedule. If I'm always telling them to put their PPE [personal*

protective equipment] *on they get pissed off. They will put the PPE on and then when I'm not there, take it off. You need it as a site rule so you can enforce it when it reduces the risk. And most of the time it does, but sometimes it doesn't reduce the risk. Then you are getting on the guys' back for something they don't want to wear, or that they don't believe makes them safer.'*

Thus, this foreman uses his personal risk judgements to determine whether rules should be strictly enforced in a particular situation. The principal contractor's foremen also commented that senior managers who establish organisational rules and procedures are 'out of touch' with the reality of site level operations. Another principal contractor foreman explained: *'...and that's where [upper level management] are so far out of it that they just have no practicality about it. They just think here's the rule book, you've got to follow it.'*

Comments made by subcontractors' workers supported the observation that some safety rule violations are tacitly ignored by the principal contractor's foremen. For example a subcontracted worker observed: *'... and gloves as well: how can you pick up screws with them? How can you tell if the cabinets are flush? You need to be able to feel. You just can't wear them then. The [principal contractor] foreman used to try and enforce the site rules, but has given up on the ones we routinely break. We just break them again when he's not around. He doesn't even bother now.'*

Subcontracted workers also described how they 'weigh up' the health and safety benefits against the time and production efficiency implications of following certain safety rules: *'They [the principal contractor] set the procedures and expectations and we have to follow that... [but] to be honest, we don't always. Some of them we don't agree with. If it doesn't make the workplace safer, and it is going to cost time, then no, we won't follow it.'*

In contrast to the flexible approach taken by the foremen, professional health and safety advisors engaged by the principal contractor argued for strict adherence to safety rules: *"... 80% of all our first aids on-site are eyes and hands. So... you can't say, "yes we're going to, as a company, relax [PPE]," because the statistics don't lie. 80% of people that have first aid incidents have either cut their fingers or got something in their eye. And the two things that people don't want to wear is gloves and glasses.'*

The principal contractor foremen's inconsistency with regard to the enforcement of safety rules was also a source of frustration to site managers: *'We need our foremen to take areas more personally. Too many are walking past obvious safety issues. For example, that ramp out there gets worse and worse every day. It is basic housekeeping. A 10 minute job, but no-one shows initiative to get it sorted until it is too late... It is like no one wants confrontation. In some areas the foreman should be giving the ultimatum that when you pack up, you clean up. And if the site is not in a good condition for the next day, we don't start. But it just gets ignored.'*

Engagement versus enforcement

Interactions between the principal contractors' foremen and subcontractor supervisors were identified as being extremely important to the management of safety, but also challenging. One foreman explained: *'Managing the drawings is not the hard bit, it's managing the people. The drawings are there, they can be shit, but they are still there. It's managing the personalities, and some of the [subcontractor] supervisors can be difficult.'*

Some foremen were observed to make a deliberate attempt to get to know subcontracted supervisors. One foreman explained: *'I spend a lot of time with the subbies and the tradies. I will sit with them rather than the other foremen at smoko. I've come from the tools, I get along with most of them. I think it helps when you build up the trust with them. Most of the other foremen don't bother. There is a bit of an "us and them", but that doesn't help.'*

Another principal contractor foreman observed that establishing mutually respectful relationships at the principal contractor-subcontractor interface increases commitment and engagement with regard to achieving the principal contractor's safety goals: *'...If you understand the guys, and the guys understand you, and you have a bit of respect there both ways, you'll end up getting this [good safety outcome]. That's the inspiration and the motivation. You get on with each other and you know, you're a half-decent human being, the guys will want to do it.'*

Subcontracted workers identified the authenticity of a foreman's concern for workers' health and safety as being an important determinant of their influence on practice: *'I'm not going to get inspiration from a [principal contractor] foreman walking around. But if they show a little bit of care about safety then – it's one thing saying "do the right thing". It's another thing whether they actually give a shit whether you're doing the right thing or not, you know. So, I think care comes into it.'*

A subcontractor supervisor also explained how safe work practices are discussed and agreed at a local level with the principal contractor foreman: *'The foreman suggests new ways of doing things to me. And will let us suggest the way we want to work too. That way of working over there, that was our SWMS [Safe Work Method Statement]. Went to the foreman, they checked it out and were happy. And we were happy 'cause it's how we are used to doing it.'*

The importance and effectiveness of this collaborative approach was described by a principal contractor site manager: *'...the foreman is out there everyday walking around, chatting to the blokes, general you know, just on a personal level as well. If they see things that aren't right, it's not just going up and telling them off. It's actually chatting to them and "hey you could do this better or do it this way". I think that works...so it's not just going up and saying, "hey, do this, you're not doing this right." It's just having that conversation, treating them like a human being.'*

In contrast to the generally collaborative approach taken by foremen, the principal contractors' professional health and safety advisors expressed a lack of trust in subcontractors' willingness to voluntarily adopt safe working practices. One health and safety advisor commented: *'They [subcontractors] are not going to set up all the systems they need for an hour's work if they don't have to. They will try and hide things, until they get caught, and then say, "oh yeah, I was going to tell you about that" ... were they hell! We keep employing the same subcontractors so they should be used to our expectations and what we want, but sometimes it doesn't feel like that. The last resort is to get them all in the shed and give them a slap.'*

The health and safety advisors described a number of punitive strategies used to achieve subcontractor compliance with health and safety expectations: *"There's only been a couple of times when we have had to get subbies in the shed and sit them down. It's been pretty good. They typically know they will need the right equipment, PPE [personal protective equipment], SWMS [Safe Work Method Statements] and all that when on our site. Sometimes they have*

their own ideas about what's right, but we often lead them our way. We can hit them in the pocket too if we need to. 40 guys re-inducted or sat down for half an hour or whatever... that costs... and then the bosses really listen."

Tensions and trade-offs

The above statement reflects the way in which hitting subcontractors in the 'hip pocket' is seen as a legitimate and effective mechanism for driving performance. However, some principal contractor personnel also acknowledge that their organisation's subcontracting practices militate against subcontractor cooperation with regard to expected health and safety standards. In one instance the researcher observed a tense exchange between a subcontractor supervisor and the principal contractor's health and safety advisor during a site walkaround. On completion of the walkaround, the health and safety advisor explained: *'They [subcontractors] are getting squeezed from a lot of sides: time, budget, us, their manager... sometimes they don't want to hear about safety.'*

A site manager similarly explained: *"We are working on a 4% margin. It is not a lot. Back in the 90s it used to be about 10% for us, and 20% for the subcontractors. Nowadays if you want to win the work you need to go that low [4%]. When you consider all the risks, all the uncertainty... We came across some unexpected contaminated land – put us six days behind. The steel over there was meant to arrive 10am yesterday, it came this morning. That doesn't just put us one day behind because we planned to pour on Friday and let it cure over the weekend. If we don't make that, we have to pour on Monday, and then Tuesday and Wednesday we are sitting around waiting. We are always at 100%, foot firmly on the accelerator, and then events like that crop up, and we are firmly under the pump. But it is either that or don't win the work. But it affects everything, absolutely everything. You can promise the client the best safety, the best quality, but you can guarantee the other guys [rival bidders] are doing the same thing... so they almost always go with the cheapest. We are all under the pump all the time, and we have to pass that pressure down to the subcontractors.'*

Industry context and culture

A lack of consistency between the health and safety expectations of different principal contractors was identified by subcontractor personnel as being a challenge at the principal contractor-subcontractor interface. Practices relating to the prevention of falling objects were highlighted as an example of this. A principal contractor foreman explained: *'It is a bit complex because there are so many levels around here – but their [the subcontractor's] supervisor needs to stop and think; we have guys working above and below and someone is going to end up dropping a hammer. It is all go sometimes, but they shouldn't have them working above and below if there are no controls. Do one level with an exclusion zone below, and then the next, or get the mesh up. That is where we [principal contractor foremen] need to step in, and make sure these things get sorted.'*

However a subcontracted worker described how: *'...on other sites it is a drop zone three metres out from the exterior of the building. But not here. It is an exclusion zone. Nothing gets dropped. It is all a perspective thing. If you can't drop something in the drop zone, where can you drop it? Here they are all about stopping the drop... The problem for us is there are all different expectations wherever we go.'*

The requirement to use lanyards (tool tethers) at all times when working next to an edge where objects could potentially be dropped was also regarded as impractical by subcontractor supervisors: *'They are impractical at times – like when they [the principal contractor] want*

you to tether a 100kg pipe to your arm. They [the principal contractor] do get on at you a bit for it.’ A subcontracted worker also explained: ‘It takes extra time [to use tool tethers]. They are impractical for some of the tasks. You become Spiderman when you have multiple tools, and then you become your own trip hazard.’ The supervisor added: ‘I can understand it for façade workers. But for other work it is just best to remove risk by putting windows in first.’ A health and safety advisor who, in this instance, was employed by the subcontractor, also observed that the tool tether requirement is not strictly enforced by the principal contractor: ‘...it depends how hard they push it – they’ve got to the stage with PPE compliance that they’ve threatened re-induction of all guys, but not with lanyards yet.’

Comments made by the principal contractor’s health and safety advisors described how hard it can be to enforce safety-related rules when these are not standard across the construction industry. One commented: *‘When you get a subbie, you have them for the job no matter how shit they are, and it is something you just have to manage...we slowly see a change in culture, we bring them to [the principal contractor’s] standards that we can’t budge on – that is what all our jobs expect. Then they go away to another job, come back, and they have reverted back to square one. And we are like, “what happened?” And you get, “no-one else expects this blah blah” It can be a constant battle.’*

The selection of subcontractors based upon lowest price was identified as a challenge for maintaining high safety standards. A principal contractor site manager explained: *‘The issue with bad subcontractors is some of them just don’t care – we can’t get rid of them, we have them for the job, and deep down they think that, come a year or two, or whenever the next job comes, if they are the cheapest, we will still go with them regardless... and they are probably right.’*

Context specific problem-solving

In some instances, principal contractor personnel were observed to actively seek the advice of subcontractors in resolving safety problems. A principal contractor health and safety advisor explained: *‘I come from a rigging/crane background. If I have to go find something out about electrical safety, that’s beyond my normal scope, well, you need to go talk to these guys, how do you actually do this? Is this practical? Is this real? May as well give me a tune up if I’m trying to implement something that’s not practical. So yeah they’ll [subcontracted supervisors] bring us to reality. Not that we intend on not being real, but if you don’t have the knowledge sometimes you can’t be practical.’*

Being respectful of subcontractors’ specialist expertise was identified as being important for effective issue-resolution. A principal contractor health and safety advisor commented: *‘...something as simple as an issue’s raised, so instead of just saying “oh, yeah, yeah, yeah, we’ll try to get to it when we can”; saying “you know what, let’s just all go and have a look at it and we’ll get everybody’s input”; instead of being a tyrant about it...I don’t know the ins and outs of what you [the specialist subcontractors] do...and I think respecting that these guys have got a lot of knowledge in their fields, don’t pretend to know more than you do, and if you’re not sure about something, get their input as well. You’re going to get a better result all round.’*

Another principal contractor health and safety advisor commented: *“So it’s got through to a number of them [subcontracted supervisors], and we would get a number of guys coming to us, either supervisors or the workers themselves, and we work around it. And they would come up with another way, but there’s some that are more naturally inclined to it. And others*

that are just like, you can imagine there's probably been a number that we haven't seen that are like "just go and do it. And don't get caught."

Subcontractor supervisors also suggested that informal interactions with workers provide an important opportunity for knowledge sharing and context-specific problem-solving in relation to working safely. One subcontractor supervisor described how: *'[We'll] sit around a couple of tables and we'll talk about, we'll chat about. It doesn't have to be a formal toolbox, we go straight after a smoko, or straight after lunch someone says, "I've got this hassle here, how do I do that?" We all sit down and take an extra minute for everyone to sit down and we sort it out on the go.'* Another supervisor agreed, commenting: *"When we're all sitting down they [the workers] can all discuss, say, "I've got this issue, do you guys have this issue?" ... and we try and resolve it between ourselves 'cause we get together as a group so many times...that most problems get resolved by the workers just talking to each other. I'm just sitting there listening, "you guys sort it all out, now let's document it."*

The research revealed the importance of lateral communication between subcontractor supervisors engaged at the same construction worksite. In particular, the ability of subcontractor supervisors to pre-empt health or safety issues, identify and resolve activities that could impact on adjacent trades was considered important. For example, one principal contractor foreman explained: *'Sometimes I would say "look, it's going to be quicker if you just ring [subcontractor supervisor's name], instead of ringing me." Because then I'll go off and try and find [subcontractor supervisor's name]. I said "if you need something done and it can be done without my involvement, just give each other a call. You know what to do, you don't have to involve me... if it doesn't need my involvement, just give each other a ring and you guys can sort it out and if it does need my involvement then give me a ring and I'll step in and see what I can do."*

Subcontracted supervisors were also observed to share health and safety-related knowledge and resources. In one example, an electrical trade supervisor intervened to discourage the practice adopted by another subcontractor of running electricity cables between levels of the same building. The electrical trade supervisor explained: *'...there are six levels here... Because of all these levels, it is about keeping on top of everything, so there is a bit of extra care and communication needed. Like that cable shouldn't be going down a level – that shouldn't happen because if there's an emergency, and you need to turn the power off, you need to get down a floor.'*

A principal contractor foreman explained how subcontractors sometimes share equipment, reducing the number of plant items operating at a worksite and the inherent risks of a congested work area: *'Cooperation's one of the key things... I was at a meeting a while ago and the elevated work platform association were there and they were sprouting on about subcontractors sharing equipment... [subcontractor A] wouldn't borrow [subcontractor B's] scissor lift because it's unsafe. And I said, "well, you tell me why it's unsafe" ... in fact it's safer because if [subcontractor A] has that scissor lift for half an hour to do a job and [subcontractor B] have got one and they can spare it, it then prevents another scissor lift being transported into site, another plant induction having to be done, another piece of equipment that possibly gets in the way. I support these sharing arrangements, provided the operators are doing the necessary checks and balances, which I expect everyone to do anyway. But it was interesting that another level of our industry were actually opposed to it because all they see is a lack of revenue. All they're interested in is if [subcontracted supervisor's name] has to go and hire a scissor lift for a half hour task, they're going to get a full day rate for it, delivering in, delivering out, it's costing 500 bucks before you know it.'*

Whereas they lend it to him for half an hour, there's no money changed hands, just next time the same favour is [returned].'

Discussion

The meaning ascribed to site safety rules

The results suggest that the way that safety is constructed and enacted in the construction site environment is complex and influenced by a range of social relationships, interactions and voices. The notion of a singular, shared understanding of safety in the construction worksite context is far from reality (see Richter and Koch, 2004, and Gherardi et al., 1998, for a discussion of differentiated safety perspectives).

At a corporate level, the principal contractor organisation has established minimum safety requirements that are prescriptive and applicable to work across all sites. These requirements include the wearing of mandated personal protective equipment, including helmets, boots, safety glasses and gloves, as well as specific measures to prevent falling objects. Sherratt (2016) points out that, although corporately set site rules establish behavioural requirements, these rules do not easily or automatically translate into uniform or compliant practice at the worksite. Our results show that, even within the principal contractor organisation, there is a lack of coherence in relation to the way that rules are understood and applied. In particular, the organisation's professional health and safety advisors and foremen were found to differ substantially in their approach to rules and their enforcement.

The findings indicate that the principal contractor's professional health and safety advisors understand safety as something that can, and needs to be, controlled from the top down. Thus, for the health and safety advisors, what constitutes 'good safety' is expressed in the company-wide mandatory safety rules. The content and intention of these rules is justified and explained by the health and safety professionals in terms of past incident and injury experience. Thus, the health and safety advisors can see a clear relationship between the corporately created site rules and the prevention of frequently occurring or serious incidents, such as hand and eye injuries, and falling object incidents. Comments made by the health and safety advisors also suggest that they do not trust subcontractors and believe that they will only follow rules if they fear being caught and punished. Consequently, the professional health and safety advisors favour a punitive disciplinary approach to managing safety at the principal contractor-subcontractor interface. The management of subcontractor safety was constructed by the health and safety advisors as an enforcement activity, in which rule violation would be punished harshly in ways that would have a significant financial impact on subcontractor organisations, and hence be noticed by 'the bosses.' The health and safety professionals described giving recalcitrant subcontractors a "slap" by requiring all of their workers to be re-inducted, costing the subcontractors time and money. This punitive approach was not well received by the subcontractors and tense (even hostile) interactions between the principal contractor's health and safety advisors and subcontractor supervisors were observed on-site.

In contrast to the health and safety advisors, the principal contractors' foremen downplayed the importance of the corporate site rules. The practicality and importance of some of these rules for controlling safety risks were questioned by the foremen who considered the corporate groups responsible for developing the rules to be "out of touch" with the realities of the site. The foremen described how they consciously engage in a 'balancing act' between enforcing site rules and maintaining effective working relationships with

subcontractors. The foremen perceived a need to keep subcontractors “on-side.” Importantly, they explained this need in terms of the potential negative consequences that poor relationships at the principal contractor-subcontractor interface could have on production. This explanation suggests that dependencies in the construction supply chain are, to some extent, reciprocal. Although principal contractors are at the top of the hierarchy of multi-level sub-contracting arrangements and the subcontractors rely on them for work, the principal contractors are also dependent upon key subcontractors to deliver projects. This bi-directional power relationship seems to play out to reduce the foremen’s willingness to strictly enforce site safety rules which have been established in response to actual safety incident experiences.

Subcontractors’ workers also described ‘choosing’ which safety rules they would follow and which they would break. The workers’ comments indicate that their resistance to rule-compliance is, to some extent at least, tolerated by the principal contractor foremen who had “given up” trying to enforce mandatory personal protective equipment (PPE) rules. The workers described how their decision to follow rules was based upon an assessment of the impact that this would have on the time taken to perform a task reflecting the fact that, in the site context, production trumps safety. However, it is the workers (rather than the subcontractor organisations) who are taking the risks. They are the ones who could potentially be hurt as a result of rule violations and, although the decision not to follow rules was tacitly sanctioned by the principal contractors’ foremen, if a serious safety incident were to occur, the finger of blame would probably be quickly pointed at the worker who broke the rules (see also, LePlat 1998).

Both the foremen and the subcontracted workers’ constructions of safety differ from those of the health and safety professionals and this plays out to shape their response to the principal contractor’s site safety rules. The health and safety professionals adopt a binary approach in which there are only two identifiable states, i.e. ‘safe’ and ‘unsafe’. Thus, if the rules are followed the work will be safe, if they are broken, it will be unsafe. Sherratt (2016) points out that the reality of a construction site is far less stable than this dichotomous approach suggests, and this is evident in the way that the foremen and subcontracted workers talked about safety. Thus, the work context was assessed, safety rules were balanced against time considerations and production imperatives were used to justify working in ways that were “slightly unsafe” (see Sherratt, 2016, p. 86).

Collaborative knowledge practices

The principal contractor organisation, like all major contracting companies operating in the Australian construction industry, has implemented a comprehensive safety management system. Safety management systems have been criticised for compartmentalising safety and marginalising practical local knowledge (Almklov et al. 2014). In turn, this is believed to negatively impact the practical usefulness and acceptance of safety rules by those expected to follow them (Knudson, 2009; Lofquist et al. 2017). The findings suggest that subcontractors do not always accept and actively resist the prescriptive site safety rules that are established by the principal contractor at a corporate level, and ‘applied’ universally at all worksites.

However, another type of rule is also used in the management of safety. These rules are context-specific expressions of how work tasks will be performed at the site, and are documented in safe work method statements and task-specific work procedures. Whereas the principal contractor’s health and safety advisors favoured a strict and punitive enforcement approach for corporately set rules, they adopted a different approach to the development of

site-specific work procedures. The health and safety advisors acknowledged that the specialist subcontractors are experts in their fields of work and actively sought their input into work planning and problem-solving to ensure that “practical” methods were applied.

Sherratt (2016) observes that a common contradiction in the practices of construction organisations arises when companies embrace participatory management philosophies that focus on engagement and aligning values, but simultaneously adopt a ‘command and control’ approach to safety management. This contradiction was apparent in our findings. Thus, the principal contractor’s attempts to impose universal safety standards across all of its projects can be contrasted with a dependency upon the local knowledge and practice of suppliers to determine the way work will be performed at a particular site. The latter will almost inevitably involve local adaptation and variability. The findings also indicated that, in some instances, collaborative knowledge practices occur laterally between subcontractors’ supervisors, who share technical knowledge with each other to support effective and safe working. The principal contractor’s foremen supported this and even suggested that, where possible, subcontractors can resolve issues between themselves without the foreman’s involvement. While this is likely to be an efficient way of working, it also raises important questions about responsibility for safety at the site.

Industry-wide practices

The findings suggest that interactions at principal contractor-subcontractor interface need to be understood as embedded within a broader industry context in which organisational, economic and cultural factors influence the way that work is performed.

The pressures brought to bear on subcontractors by the processes of competitive tendering and price-based decision-making were recognised by the principal contractor’s personnel. The need to cut costs to win work, resulting in reduced margins and intense cost and time pressures were observed to “affect everything” in the way projects are delivered. Even the principal contractor’s health and safety advisors, acknowledged that subcontractors are under such intense production pressure that they experience safety-related requests as an additional (and unwanted) burden.

The social negotiation of work practices and safety at the principal contractor-subcontractor interface is also influenced by safety standards in the broader construction industry environment. Thus, subcontracted workers identified experiencing the “different expectations” of principal contractors as a problem for subcontractors. Principal contractor health and safety advisors were also frustrated that subcontractors challenged the site safety rules established by the principal contractor on the grounds that other principal contractors did not require similar measures, for example, in relation to the requirement for exclusion zones and tool tethers. Further, the principal contractor’s managers perceived their leverage over subcontractors to be limited because, once a subcontractor is engaged, the principal contractor is highly dependent upon them to meet project deadlines. Managers also observed that the construction industry market is such that even poorly performing subcontractors are likely to be selected for future works if they offer the most competitive price.

Conclusions

Previous research has identified the importance of communication between supervisors and workers for safety in construction workgroups. However, relatively little research has examined in detail, the nature and impact of social interactions in determining safety practices in the dynamic construction industry environment. This research addressed this gap, using an in-depth ethnographic research approach. The research highlights the need to

understand the principal contractor-subcontractor interface as a complex social ecosystem, in which professional, organisational and industry cultures interact to shape participants' safety attitudes and behaviours. Within this ecosystem, no single shared understanding of what is safe and what is dangerous exists. Even within the principal contractor organisation, different actors differ in their safety orientation and the meaning they attribute to site safety rules.

Safety can be regarded as an emergent property of the site context, in which work practices are subject to ongoing negotiation and the operation of a complex web of power relations. This was evident, for example, in subcontractors' open resistance to some of the principal contractor's site safety rules and foremen's hesitation to enforce rules to keep subcontractors 'on-side' in order to meet project deadlines. Dependencies in the construction supply network and pressures emanating from competitive tendering processes at the client-principal contractor and the principal-contractor interfaces also identified as having an impact on work practices and safety.

The research has implications for theory and practice. The results highlight the importance of understanding the social construction of safety at the construction worksite and, in particular, the limitations associated with technical systems-based approaches that assume that safety can be managed through the establishment of prescriptive and context-free rules.

The relationship between rules, work practices and safety far from straightforward and is subject to interpretation and differences in understanding. The interaction between different perspectives plays out in a process of ongoing negotiation between health and safety professionals, multiple levels of supervision and workers at the principal contractor-subcontractor interface. The interactions at the interface between these actor groups needs to be understood in order to ensure that social, cultural and economic barriers to the attainment of desired standards of safety are identified and addressed.

Further, and consistent with social-ecological systems theory, the nesting of the construction site social ecosystem within the operation of the larger ecosystem of the Australian construction industry needs to be understood. Thus, competitive tendering and subcontracting practices, as well as the level of safety expectation of other principal contractors operating in the construction market will also shape the way that work and safety are negotiated and enacted in the worksite context. Future research should further investigate the principal contractor-subcontractor interface, drawing on these insights and extending the consideration and application of social-ecological systems theory.

Limitations and future research

In ethnographic research the aim is not one of statistical generalization, but rather analytical generalization (see Yin, 2013). Hence, one limitation of this approach is that the extension of the findings from this study to other geographic regions and project contexts is theoretical only. It is recommended that further research is undertaken to investigate whether these findings are generalizable to other contexts. In terms of validity, proponents of ethnography argue this is its major strength because: (i) the relatively long data collection period allows for extended analysis, refinement and interpretation of data, and (ii) data collection occurs in a natural, rather than a contrived, setting (LeCompte & Goetz, 1982).

In ethnographic research, the analysis of observational data involves interpretation by the researcher. While, researcher bias exists in all research (Smith & Noble, 2014), minimising the threat posed by researcher bias in ethnographic research is important. In the current

research this was achieved through the use of focus groups to examine the reactions of site-based personnel to the interpretation of the data collected (see, LeCompte & Goetz, 1982, for a discussion of the use of participant researchers to minimise the threat of bias). Nevertheless, while the focus groups reduced the threat of researcher bias, it cannot be entirely eliminated in ethnographic research. Thus, it is recommended that further studies of social processes and health and safety at the principal contractor-subcontractor interface are undertaken using complementary research methods.

Data availability statement

Data generated or analyzed during the study are available from the corresponding author by request.

References

- Almklov, P. G., Rosness, R., & Størkersen, K. (2014). When safety science meets the practitioners: Does safety science contribute to marginalization of practical knowledge? *Safety Science*, 67, 25-36.
- Alper, S. J. & Karsh, B-T., (2009), A systematic review of safety violations in industry. *Accident Analysis and Prevention*, 41, 739-754.
- Arditi D., & Chotibhongs, R. (2005). Issues in subcontracting practice. *Journal of Construction Engineering and Management*, 131(8), 866-876.
- Borys, D. (2012) The role of safe work method statements in the Australian construction industry, *Safety Science*, 50(2), 210-220
- Braun, V. & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, 3(2), 77-101.
- Briscoe, G., & Dainty, A. (2005). Construction supply chain integration: an elusive goal?. *Supply Chain Management: An International Journal*, 10(4), 319-326.
- Dekker, S. (2004). *Ten Questions about Human Error: A New View of Human Factors and System Safety*. CRC Press. Boca Raton, FL.
- Dekker, S. (2015). *Safety Differently: Human Factors for a New Era* (2nd Edition), CRC Press. Boca Raton, FL.
- Dubois, A., & Gadde, L. E. (2000). Supply strategy and network effects—purchasing behaviour in the construction industry. *European Journal of Purchasing & Supply Management*, 6(3-4), 207-215.
- Finneran, A., Hartley, R., Gibb, A., Cheyne, A., & Bust, P. (2012). Learning to adapt health and safety initiatives from mega projects: An Olympic case study. *Policy Practice Health Safety*, 10 (2), 81-102.
- Fugas, C. S., Meliá, J. L., & Silva, S. A. (2011). The “is” and the “ought”: How do perceived social norms influence safety behaviors at work? *Journal of Occupational Health Psychology*, 16(1), 67-79.
- Gherardi, S., & Nicolini, D. (2000a). The organizational learning of safety in communities of practice. *Journal of Management Inquiry*, 9(1), 7-18.
- Gherardi, S., & Nicolini, D. (2002). Learning the trade: A culture of safety in practice. *Organization*, 9(2), 191-223.
- Gherardi, S., Nicolini, D., & Odella, F. (1998). What do you mean by safety? Conflicting perspectives on accident causation and safety management in a construction firm. *Journal of Contingencies and Crisis Management*, 6(4), 202-213.
- Guest, G., Bunce, A., & Johnson, L. (2006). How many interviews are enough? An experiment with data saturation and variability. *Field Methods*, 18(1), 59-82.
- Hale, A. & Borys, D. (2013). Working to Rule, or Working Safely. In *Trapping Safety into Rules*, C. Bieder and M. Bourrier (Eds), Ashgate Publishing Ltd, Farnham, 43-68.
- Hammersley, M. & Atkinson, P. (2007). *Ethnography: Principles in practice* (3rd ed.): Routledge.
- Hardison, D., Behm, M., Hallowell, M. R., & Fonooni, H. (2014). Identifying construction supervisor competencies for effective site safety. *Safety Science*, 65, 45-53.

Hartmann, A., & Caerteling, J. (2010). Subcontractor procurement in construction: the interplay of price and trust. *Supply Chain Management: An International Journal*, 15(5), 354-362.

Jeschke, K. C., Kines, P., Rasmussen, L., Andersen, L. P. S., Dyreborg, J., Ajslev, J., ... & Andersen, L. L. (2017). Process evaluation of a Toolbox-training program for construction foremen in Denmark. *Safety Science*, 94, 152-160.

Johnston, L. (2006). Software and method: Reflections on teaching and using QSR NVivo in doctoral research. *International Journal of Social Research Methodology*, 9(5), 379-391.

Kines, P., Andersen, L. P., Spangenberg, S., Mikkelsen, K. L., Dyreborg, J., & Zohar, D. (2010). Improving construction site safety through leader-based verbal safety communication. *Journal of Safety Research*, 41(5), 399-406.

Knudsen, F. (2009). Paperwork at the service of safety? Workers' reluctance against written procedures exemplified by the concept of 'seamanship'. *Safety Science*, 47(2), 295-303.

LeCompte, M., & Goetz, J. (1982) Problems of Reliability and Validity in Ethnographic Research, *Review of Educational Research*, 52(1), 31-60

LePlat, J., (1998), About implementation of safety rules. *Safety Science*, 29, 189-204.

Lingard, H., Cooke T. & Blismas, N., (2010), Safety climate in conditions of construction subcontracting: A multi-level analysis. *Construction Management and Economics*, 28, pp. 313-825.

Lofquist, E. A., Dyson, P. K., & Trønnes, S. N. (2017). Mind the gap: a qualitative approach to assessing why different sub-cultures within high-risk industries interpret safety rule gaps in different ways. *Safety Science*, 92, 241-256.

Loosemore, M., & Andonakis, N. (2007). Barriers to implementing OHS reforms—The experiences of small subcontractors in the Australian Construction Industry. *International Journal of Project Management*, 25(6), 579-588.

Löwstedt, M. (2015). Taking off my glasses in order to see: exploring practice on a building site using self-reflexive ethnography. *Construction Management and Economics*, 33(5), 404–414.

Manu, P., Ankrah, N., Proverbs, D., & Suresh, S. (2013). Mitigating the health and safety influence of subcontracting in construction: The approach of main contractors. *International Journal of Project Management*, 31(7), 1017-1026.

Mayhew, C., & Quinlan, M. (1997). Subcontracting and occupational health and safety in the residential building industry. *Industrial Relations Journal*, 28(3), 192-205.

Mayhew, C., Quinlan, M., & Ferris, R., (1997). The effects of subcontracting/outsourcing on occupational health and safety: survey evidence from four Australian industries. *Safety Science* 25, 163–178.

McDermott, V., & Hayes, J. (2016). Risk shifting and disorganization in multi-tier contracting chains: The implications for public safety. *Safety Science*.

O'Reilly, K. (2012). *Ethnographic methods*: Routledge.

Oswald, D., Sherratt, F. and Smith, S. (2014). Handling the Hawthorne Effect: the challenges surrounding a participant observer. *Review of Social Studies*, 1(1) 53-73.

Oswald, D., Wade, F., Sherratt, F. & Smith, S. (2019b) Communicating health and safety on a multinational construction project: challenges and strategies, *Journal of Construction Engineering & Management*, 145 (4), 04019017

- Oswald, D., Sherratt, F., Smith, S., & Dainty, A. (2018) An exploration into the implications of the 'compensation culture' on construction safety, *Safety Science*, 109, 294-302
- Ozmec, M. N., Larlsen, I. L., Kines, P., Anderson, L. P. S. & Nielsen, K. J., (2015), Negotiating safety practice in small construction companies. *Safety Science*, 71, 275-281.
- Phelps, A. F. & Horman, M. J. (2010). Ethnographic Theory-Building Research in Construction. *Journal of Construction Engineering and Management*, 136(1), 58-65.
- Pink, S., Tutt, D. & Dainty, A. (2013), *Ethnographic Research in the Construction Industry*, Routledge: Oxon
- Pole, C., & Morrison, M. (2003), Ethnography for Education, McGraw-Hill Education: London Richards, L. (1999). Data alive! The thinking behind NVivo. *Qualitative Health Research*, 9(3), 412-428.
- Richter, A. & Koch, C., (2004), Integration, differentiation and ambiguity in safety cultures. *Safety Science*, 42(8), 703-722.
- Sherratt, F., (2016), *Unpacking construction site safety*, Wiley Blackwell, Chichester.
- Small, M. (2009) 'How many cases do I need?' On science and the logic of case selection in field-based research, *Ethnography*, 10(1), 5-38.
- Smith, J. & Noble, H. (2014) Bias in research, *Evidence-Based Nursing*, 17(4), 100-101.
- Therkelsen, D. J., & Fiebich, C. L. (2004). The supervisor: The linchpin of employee relations. *Journal of Communication Management*, 8(2), 120-129.
- Turner, N., & Gray, G. C. (2009). Socially constructing safety. *Human Relations*, 62(9), 1259-1266.
- Tutt, D., Pink, S., Dainty, A. R. J., & Gibb, A. (2013). Building networks to work: an ethnographic study of informal routes into the UK construction industry and pathways for migrant up-skilling. *Construction Management and Economics*, 31(10), 1025-1037.
- Von der Heyde, A., Brandhorst, S. & Kluge, A., (2015), The impact of safety audit timing and framing of the production outcomes on safety-related rule violations in a simulated production environment. *Safety Science*, 77, 205-213.
- Wadick, P. (2010). Safety culture among subcontractors in the domestic housing construction industry. *Structural Survey*, 28(2), 108-120.
- Yin, R. (2013). Validity and generalization in future case study evaluations, *Evaluation*, 19(3) 321-332.
- Zohar, D. (2000). A group-level model of safety climate: testing the effect of group climate on microaccidents in manufacturing jobs. *Journal of Applied Psychology*, 85(4), 587.
- Zou, P. X., Sunindijo, R. Y., & Dainty, A. R. (2014). A mixed methods research design for bridging the gap between research and practice in construction safety. *Safety Science*, 70, 316-326.