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## **PERCEPTIONS OF ACCIDENT RISK AMONG ON-TRACK MACHINE WORKERS: AN INTERVIEW STUDY**

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Although non-fatal injuries remain a frequent occurrence in safety-critical work, very few studies have examined the ways in which organisational systems and processes influence individual safety behaviour. Even fewer have explored the perceived factors contributing to accident risk using qualitative research methods. This short paper presents the initial results from a thematic analysis of ten interviews with On Track Machine (OTM) operatives. Issues arising from two key themes (fatigue, and safety communication and training) are briefly described. Implications, planned organisational response, and opportunities for further research are discussed.

### **Introduction**

UK Health and Safety Executive (HSE) 11/12 statistics suggest that fatal injury rates at work have shown a downward trend in recent years (173 deaths in 11/12 compared with 233 in 07/08). According to the same statistics, while there has been a similar decline in the number non-fatal injuries, they remain a frequent occurrence in the workplace (111,164 reported to an employer in 11/12). In addition to the pain and suffering caused, the financial costs of workplace injuries and illness are estimated at £7.2 billion (in 10/11) for individuals, and £3.2 billion (in 10/11) for companies, There is a need to examine the factors that

influence accident risk in the workplace, for the benefit of both frontline workers, and their employers.

Accident prediction is complex and difficult, largely due to the number of potential contributing factors. The majority of safety research has focussed on the evaluation of organisational safety practices, and more specifically initiatives designed to improve the safety culture of an organisation as a whole (Choudhry, Fang, & Mohamed, 2007). While there have been some positive developments in the design and redesign of workplaces, work tasks, and tools, and in some cases improvements in awareness training, these are largely the result of top-down processes where the importance of the psychological and behavioural conditions of the individual worker has, to a degree, been neglected (Mohamed, 2002). For example, very few studies have examined the ways in which organisational factors influence individual safety behaviour at work, and even fewer have gathered information about frontline employee perceptions using qualitative research methods (e.g. interviews with staff, see Choudhry & Fang, 2008; Farrington-Darby, Pickup, & Wilson, 2005). The underutilisation of qualitative research methodology is surprising given that the acknowledgement and use of frontline worker knowledge and experience is thought to be a central component in High-Reliability Organizations (HROs), and positive safety-cultures (see Jeffcott, Pidgeon, Weyman, & Walls, 2006).

This short paper presents the preliminary findings from a qualitative study of frontline safety-critical worker perceptions of accident risk. It represents the first phase of an ongoing research partnership between Sheffield Hallam University and VolkerRail Ltd. VolkerRail provides a wide range of contracting services to the railway industry from major capital projects to track renewals, and specialised operations including signalling, welding, on-track plant and machinery and overhead power supply. The majority of operations are classified as safety-critical. However, VolkerRail has a good safety record and low accident rates. Despite this, the company is keen to further enhance its safety-culture, and reduce accident risk. The principal aim of the present study was to explore the perceived factors contributing to accident risk in On-Track Machine operation. A second aim was to assess the perceived value of organisational safety training and initiatives, particularly when accident risk is high. In the fulfilment of these aims it was hoped that issues of immediate concern for VolkerRail would be established, and that as a consequence, potential system and process changes, and/or the necessity for further research, would be identified.

## **Method**

### *Design and Interview Schedule*

The present study adopted a qualitative design using semi-structured interviews. The development of the interview schedule was an iterative process guided by academic research questions and specific areas of interest for VolkerRail HSQE

personnel. The agreed focus was on training, safety at work, support and coping, and critical incidents.

### *Participants*

A briefing letter was distributed to all VolkerRail employees via email, and posted on the company intranet site. Letters containing a copy of the briefing sheet were also sent to OTM operatives along with an invitation to take part in the interviews. OTM workers were asked to contact their line manager should they wish to volunteer. The names of interested parties were sent to the OTM business manager who allocated time on work plans to enable participation. Ten OTM operatives volunteered to take part.

### *Interview Procedure*

Ten OTM operatives were interviewed by university researchers at a plant maintenance depot. Interviews were recorded using a digital recording device and ranged from 1 to 2.5 hours in duration. In preparation for qualitative analysis, all 17.5 hours of recorded interview data was anonymised and transcribed.

## **Results**

### *Thematic Analysis*

Transcribed data was analysed for themes using a process of constant comparative analysis. Thematic analysis was conducted by two experienced qualitative researchers. Firstly, each researcher analysed the same two transcripts, and identified themes individually. Together, via discussion, they developed a thematic matrix. The matrix was then used to encode the remaining 8 transcripts, of which 4 were analysed by each researcher. Additional themes were added to the matrix as required, and the matrix was finalised, again through discussion between the two researchers and within the larger research team.

### *Themes Description*

A range of themes and sub-themes were identified in the interview data. Issues arising from two key themes (fatigue, and safety communication and training) are briefly described below, alongside selected illustrative quotations from the interview transcripts.

#### *Theme 1. Fatigue*

A key finding from the interview study was the extent of fatigue reported by participants (despite working within the limits of working time regulations). It seems that this is experienced as a continual and challenging aspect of their day-to-day working lives. Fatigue resulted from a combination of job-related factors, including the rostering system and shift work, and 'downtime' during work hours spent waiting for jobs to start. Fatigue impacted upon participants' emotional well-being, their coping strategies, and upon their safety.

*Fatigue, time pressure, and safety.* There was evidence that fatigue and time pressure combined to cause workers to alter their decision making processes. For example, participants believed that during standard operations they, and their colleagues, were very careful in following rules. However, participants spoke of sometimes bending rules when time pressured to get a job done quickly and/or when fatigued. In these circumstances interviewees also revealed that fatigue-induced errors of judgement were more likely. Participants stated that accident and incident risk was higher when fatigued, or time pressured, or both. Extract 1 (Participant 8) illustrates these points.

Extract 1:

*“It was a simple mistake. All I've done, I've knocked the two wrong switches. There's four switches, and I knocked the two middle ones out whereas I should have knocked the two outside ones (and you felt you'd done that...?) I was rushing and too tired.”*

*The rostering system and shift work.* Most frequently mentioned as a source of fatigue and work-related stress was the rostering system, including long hours (although not excessive), the expectation of working overtime due to overrunning works, and changes from night to day shifts, and day to night shifts, as indicated in Extract 2 (Participant 2).

Extract 2:

*“On top of all that [work pressure] you got the added issues of fatigue because the hours are very anti-social. The rostering could be a lot better when it comes to between day and night.”*

Participants in this study believed the person creating rosters had little insight into the realities of their working lives. Changing shift patterns, long working hours and two weeks advance notice of rosters had a detrimental impact their personal and family lives. These points are illustrated in Extracts 3 and 4 (Participant 1).

Extract 3:

*“They don't seem to put any thought into your welfare. See, the roster clerk works Monday 9-5. I don't think she has any idea what it's like to work the kind of shifts we do or she wouldn't roster us like that.”*

Extract 4:

*“Imagine, you're up all Saturday night, you get home say eight o'clock Sunday morning, you've then got, you can't stay awake all day or you're grumpy, cos you've got a home-life as well [interviewer: yeah, of course]. You're grumpy, you're hard work, so you're trying to go to bed for a couple of hours, but if you*

*have too much sleep, you can't sleep Sunday night and you're working Monday morning, so that just puts stress on you straightaway."*

'Downtime'. 'Downtime' refers to the often lengthy periods when workers are waiting to start on a booked job. During this time, their accumulated fatigue often results in loss of energy and alertness, which they quickly have to regain once the job commences. In addition, this wasted time is often followed by time pressure, as they attempted to complete a job before the end of their allocated shift, as demonstrated in Extract 5 (Participant 7).

Extract 5:

*"It depends what sort of job it is, say if it's a renewal, and you're sat for hours, you know you're going to be over-run, and you know you've got to be, someone's obviously got to do the job [interviewer: yeah] otherwise they can't have their track back, so, yeah, there is pressure in that."*

The long periods of downtime, followed by rushing, was perceived to add to the workers' fatigue, stress and accident risk, as expressed by Participant 1 in Extract 6.

Extract 6:

*"Times like when we've got downtime on a night shift, when you're starting late into the shift and you're in the kind of switched off mode and you're trying to... [interviewer: it's hard to get yourself back into that work mode?] Yeah, yeah you can miss things, and you can, it can be more dangerous, and when they're trying to rush you about at the end of a shift that's horrible. I don't like that."*

## *Theme 2. Safety Communication and Training*

The interview findings suggest that some methods of safety communication and training have worked very well, whilst others have been less effective in reducing accident risk for frontline workers. In general, workers felt that rule- or practical- based safety communication and training was more effective than awareness training and 'soft, transient safety initiatives'.

*Practical-based training.* Participants recalled the hard-hitting experience of having train speeds demonstrated to them through real-life experience, as expressed by Participant 1 in Extract 7:

Extract 7:

*"I think the main thing that stuck with me were the speed of trains. How fast they approach y'know. If you've got a train 125 mph and you think, you're looking up a track before you're going to cross the track and you have a quick look and you can see perhaps a half a mile and then you look away and then you start walking, it can be there."*

*The perception of 'soft, transient initiatives'.* Participants spoke about the importance of personal responsibility and taking responsibility for the safety of others, particularly members of their team. They spoke of being vigilant of risks, following rules and procedures in order to reduce risk, and the need to assess situations carefully. New 'soft, transient initiatives' were seen to be in stark contrast to the 'hard line' rulebook, which all workers had to follow. This is evident in the following extract from Participant 4, where the recent initiative was not seen as relevant to OTM workers:

Extract 8:

*"I think that's more of a workshop based thing, or round the offices, or round the yard here. Not so much on a machine because if anything happens with us on the machines, you report straight to control anyway. We're always in touch with control when we're working."*

These contrasting thoughts about an initiative and the rule book can also be seen in the following extract, in this case from Participant 1, where participants were somewhat woolly in their recall of a recent initiative:

Extract 9:

*"I have read them and I have read what the AIM stands for but I just can't remember so it's obviously not had that much effect on me."*

## **Implications**

These findings are in line with previous organisational research on the potential negative effects of shiftwork on fatigue (see Åkerstedt, 2003 for a review), and fatigue on safety (see Williamson et al., 2011 for a review). They also suggest that downtime followed by time pressure can exacerbate these effects. The results concerning safety communication and training effectiveness are also consistent with recent research literature from other safety-critical domains (such as healthcare), which has emphasised the need to go beyond didactic risk awareness training towards practical- or simulation-based approaches (e.g., Vadrnais et al., 2012). There is also evidence that for rail engineers in particular, mental simulation training may also be effective alongside these methods (see Morgan, Jones, & Harris, 2013).

## **Organisational Recommendations and Response**

After considering the existing research evidence and the OTM interview responses a number of recommendations were presented to the company. A summary of the arising issues and the planned organisational response are outlined in table 1.

**Table 1: Organisational issues and planned response**

Arising Issues	Planned Response
<p><i>Shift scheduling.</i> VolkerRail strictly abides by working time legislation. However, a number of rostering issues were apparent, including; long hours, moving from nights to days and days to nights, an expectation to work overtime, short-notice for upcoming shifts, end of shift arrangements, and interference with home life.</p>	<p>VolkerRail plans to review their shift scheduling system in order to minimise accident risk. This process may take some time and may require input from external agencies. However, less complex, more immediate changes are also planned to ensure workers retain a healthy work-life balance and are able to recuperate sufficiently between shifts.</p>
<p><i>Downtime &amp; time pressure.</i> Due to the coordination of multiagency activities in rail work, downtime for OTM operatives is unavoidable. However, if not managed properly this downtime can exacerbate negative fatigue effects on accident risk, especially if followed by intense time pressure.</p>	<p>While the opportunity for system and process changes are limited, VolkerRail will work with university researchers to identify appropriate and effective methods to minimise worker fatigue during periods of downtime and prepare them for potentially imminent time pressure (see further research section, below).</p>
<p><i>Safety communication &amp; training.</i> Non-role relevant, soft and transient safety initiatives do not reduce accident risk. Practical- and/or rule-based initiatives are more likely to be processed by workers.</p>	<p>VolkerRail will conduct an audit of current safety communication and training initiatives. Using a participatory approach that draws on the thoughts and experience of frontline workers, in combination with research evidence, the effectiveness of safety information transfer will be maximised.</p>

## Further Research

These preliminary findings have resulted in organisational recommendations, and planned system changes aimed at reducing accident risk for OTM workers. In addition, the requirement for further research has been identified. In order to maximise the effectiveness of planned organisational changes relevant empirical data must be collected before, during and after implementation. This approach ensures that if an intervention does not have a measurable effect on a specific variable, for example, performance immediately after a period of downtime, then it can be improved or replaced. Because the efficacy of organisational changes is rarely empirically evaluated, the evolution of applied research and good work practice are restrained. However, by testing the impact of novel interventions on organisational outcomes there are mutual benefits for the company and the research community.



## Conclusion

This short paper demonstrates the potential utility of qualitative research in the identification of accident risk antecedents for safety-critical workers. It also highlights the importance of company engagement in proactive initiatives designed to further reduce accident risk and enhance safety-culture, irrespective of recent accident frequency.

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