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UK rail workers' perceptions of accident risk factors: An exploratory study

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ABSTRACT

Although non-fatal injuries remain a frequent occurrence in Rail work, very few studies have attempted to identify the perceived factors contributing to accident risk using qualitative research methods. This paper presents the results from a thematic analysis of ten interviews with On Track Machine (OTM) operatives. The inductive methodological approach generated five themes, of which two are discussed here in detail, 'Pressure and fatigue', and 'Decision making and errors'. It is concluded that for companies committed to proactive accident risk reduction, irrespective of current injury rates, the collection and analysis of worker narratives and broader psychological data across safety-critical job roles may prove beneficial.

1. Introduction

The UK Network Rail workforce safety statistics for the five years preceding, and including 2013/2014, show that while fatal worker injury rates have remained consistently low with three deaths in both 2009/10 and 2013/14, major injuries have risen over this period, from 96 to 122, and lost time injuries have risen from 146 in 2009/10 to 310 in 2013/14 (Network Rail, 2014). In addition to the pain and suffering caused, the financial cost of workplace injuries and illness is high for both individuals and for companies, estimated at £14.3 billion in 2013/14, of which workplace injuries (including deaths) cost £4.9 billion (HSE, 2015). Network Rail has identified three principal safety risks for rail workers; being hit by a train, on-track plant, or a road rail vehicle; electrocution from overhead power lines or conductor rails; and trips and falls. The seriousness of these risks alongside injury rates consistently above zero provides a clear rationale for further research to identify, examine and understand the factors that influence accident risk in railway work.

Accident prediction is complex, largely due to the number of potential contributing factors. Since the early 1990's safety-critical industries (including healthcare and aviation) have adopted a "systems" approach to safety management (Reason, 1995). This approach is important because it recognises that although frontline employees are prone to human error, this is promoted or permitted by system features such as environmental factors, operator condition, personnel factors, unsafe supervision, and wider organisational influences (Wiegmann and Shappell, 2003). In a number of high-risk domains, including healthcare, specific frameworks for studying work systems have been proposed (e.g. System Engineering Initiative for Patient Safety, Carayon et al., 2006; Yorkshire Contributory Factors Framework, Lawton et al., 2012b).

Rail safety research and management has until recently lagged behind other safety-critical industries in the development and use of domain-specific error and contributory factor identification methods and tools (Baysari et al., 2008). Instead, the focus has been on evaluating and enhancing rail safety culture and climate (e.g.

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Colley and Neal, 2012). While this general approach is important, and continues to be the most popular, a number of rail safety researchers have begun to adapt existing classification methods, used in other industries, in an attempt to systematically identify active and latent system failures in rail operation with a view to developing intervention strategies for minimizing error and reducing accident risk. The most common methodological approach utilised in these studies has been root cause analysis of archival accident investigation data (Baysari et al., 2008; Read et al., 2012; Reinach and Viale, 2006). A common factor identified as contributing to accidents and incidents across these studies is decreased alertness and physical fatigue in frontline rail workers, but other factors include poor equipment design and equipment failure, the physical environment, inadequate training, and high workload. In the most recent of these studies, Read et al. (2012) used the Contributing Factors Framework (CFF) to code ninety-six investigation reports into Australian rail incidents and accidents that had occurred over a retrospective ten-year period. Their results supported all three of their study hypotheses. Firstly, they found that task demand factors (such as high workload, distractions, and time pressure) were associated with skill-based errors (including memory and attention lapses). In contrast, they also revealed that accidents and incidents attributed to mistakes (knowledge- or rule-based errors) were significantly associated with knowledge and training deficiencies. Thirdly, they found that social environmental factors such as social norms were associated with violations. While this study is one of very few to apply a contributory factors framework to rail accident data, it is notable that the findings were comparable with those of previous research exploring the relationships between errors and contributing factors in non-rail incidents and accidents (e.g. Hobbs and Kanki, 2008; Hobbs and Williamson, 2003).

The utilisation of contributory factor frameworks in rail safety management represents a considerable move forward and has provided the rail industry with some general guidance with respect to the role of system features, such as the importance of equipment reliability as well as worker condition, knowledge, and training. However, there are a number of limitations associated with the methods and tools used. In particular, the subjective, reductionist, and reactive nature of the factor identification process can be questioned. For example, not all of the accident investigations analysed in these studies have followed the same methodologies, and the way in which the evidence has been interpreted is dependent on a particular investigator's background and prior experience (Read et al., 2012).

The factor coding process has also lacked objectivity and in some instances has led to considerable disparity between raters (Baysari et al., 2008). Also, the use of frameworks that classify the conditions that promote human error fail to completely encapsulate the complexity of the causal links between, and combinations of, contributory factors at different levels of the system (Read et al., 2012). The reliance on archival accident and incident data across numerous rail worker job roles is a further criticism of this approach. For safety-critical organisations to remain vigilant and error tolerant, they need to take a proactive approach to minimising future accident risk as well as reacting to past events (Reason, 2008).

A largely overlooked alternative means of examining contributory factors is to use interviews to explore worker perceptions of the causes of past adverse incidents or accidents, and to gather information about system conditions that are perceived to heighten current and future accident risk. The underutilisation of this qualitative approach is surprising given that the acknowledgement of, and use of frontline worker knowledge and experience is thought to be a central component in High-Reliability Organisations (HROs), and positive safety-cultures (Jeffcott et al., 2006). In other high-risk domains such as healthcare, researchers have begun to recognise the effectiveness of interview techniques in gaining rich information regarding causes of patient safety breaches (e.g. Lawton et al., 2012a; Silen-Lipponen et al., 2005). To our knowledge, however, there is only one published journal article, to date, that describes the use of interviews within the area of rail safety research (see Farrington-Darby et al., 2005).

Using the Schein (1990) organisational culture model to build a conceptual framework to guide the design of their interview schedule and analysis of their data, Farrington-Darby et al. (2005) identified forty underlying factors that influence safe behaviour and a safe culture for railway maintenance workers. In addition to cataloguing their findings, Farrington-Darby and colleagues also provide a useful account of their interview process and the way in which the findings were presented to the commissioning rail engineering company, as well as the organisation's subsequent response. A fundamental limitation of their work, however, is that the authors were only able to identify and list these factors rather than explore them in any depth. Nevertheless, while the authors do not describe them as such, it appears that their list may include system features that could be classified as contributory factors in unsafe track work. For example, if one were to use the categorisation of system conditions described by Wiegmann and Shappell (2003) as a guiding framework, Farrington-Darby et al.'s list of forty factors include those that could be classified as environmental factors such as "physical conditions", and "working hours", as well as operator conditions, such as "individual perception of what safe is", "knowledge and understanding", and "fatigue, concentration, ability to function". Their list also contains personnel factors like "inconsistent teams/subcontractors", "communication on the job (excessive and poor quality)", and "training methods". Factors that, using a systems approach could be categorised under unsafe supervision were also listed, such as "setting up site safety on the day", "supervisors technical competencies", and "supervisors presence". A number of factors could also be described as wider organisational influences. For example, "rule dissemination", "equipment (condition, appropriateness and availability)", "methods for reporting", "feedback cycle", "information/communication route clarity", and "rule book usability and availability".

The Farrington-Darby et al. (2005) study has informed the work of rail safety practitioners and researchers (represented by over 75 citations, at the time of writing), however, its impact is somewhat limited by a number of theoretical and methodological flaws. First, the paper makes no distinction between the perceived influence of safety culture (defined as shared norms and values about safety), and the perceived influence of contributory factors, on the unsafe behaviour of rail maintenance engineers, even though these two constructs are usually separated (e.g. Colley and Neal, 2012; Read et al., 2012). This lack of clarity impairs the already restricted utility of the study findings (i.e. the listing rather than discussion of factors). Secondly, the use of a conceptual model derived from the literature on organisational culture to guide the design of the interview schedule and the coding of data by subject-matter experts affords a similar lack of objectivity evident in studies that have used rail-specific contributory frameworks in the analysis of accident and incident data (Baysari et al., 2008; Read et al., 2012; Reinach and Viale, 2006).

2. Research aims

The present paper documents an exploratory interview study conducted in collaboration with a rail engineering company with a good safety record and low accident rates. The principal aim was to proactively identify the factors contributing to accident risk in On Track Machine (OTM) operation as perceived by a specialist group