RAIL STAFF FATIGUE – THE GB REGULATOR'S PERSPECTIVE ON MANAGING THE RISKS

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SUMMARY

Managing staff fatigue remains a difficult issue for organisations worldwide, especially in high hazard sectors where a fatigue-related error can have disastrous consequences. Employers must balance safety and efficiency, whilst staff and unions seek their own balance of working time, time off, pay and linked issues. This paper outlines the approach to managing rail staff fatigue advocated in revised guidance from Britain's safety and economic railway regulator. Some key elements of a holistic "Fatigue Risk Management System" approach are outlined. The use of a checklist to assess existing fatigue controls is described, considering in turn the elements of: Policy; Organising; Planning & implementing; Monitoring; Auditing and Reviewing. Fatigue tools are briefly outlined, emphasising their limitations. "Triangulating" the position on fatigue helps companies assess likely fatigue risks by combining elements from published good practice guidelines, a fatigue tool, and information about how fatiguing staff find their working patterns in reality. The central importance of an open, trusting, "just" culture is emphasised, advocating collaboration between employer, staff and unions on controlling fatigue risks. Although there are is no "magic wand" for resolving fatigue issues, the paper illustrates one suggested approach to identifying and reducing risks from fatigue, to evolve working patterns and fatigue controls over the medium to longer term.

INTRODUCTION

What do we mean by fatigue, and why is it important?

Although most people would say they have experienced "fatigue" at some time in their lives, there is no universally agreed definition of the term [1, 2]. However, most definitions involve broadly similar elements so, for the purposes of this paper, fatigue is considered as "*a state of perceived weariness that can result from prolonged working, heavy workload, insufficient rest and inadequate sleep*".

Various factors contribute to fatigue, generally by reducing sleep duration, extending hours awake or disrupting the timing of sleeping and waking periods. Factors affecting fatigue include:

- work related factors e.g. timing of working and resting periods, length and number of consecutive work duties, intensity of work demands;
- individual factors e.g. lifestyle, age, diet, medical conditions, drug and alcohol use, which can all affect the duration and quality of sleep;
- environmental factors e.g. family and domestic circumstances, the sleeping environment.

A fatigued person will be less alert, less able to process information, will take longer to react and make decisions, and will have less interest in working compared to a person who is not fatigued. Fatigue increases the likelihood of errors and adversely affects performance [3], especially in tasks requiring: vigilance and monitoring; decision making; awareness; fast reaction time; tracking ability; and memory. These effects are clearly potentially very dangerous in key rail roles such as train driver and signaller, but

may also create risk for other staff, for instance maintenance staff working near moving trains or with dangerous plant, working at height, doing electrical work or driving home after a long night shift.

Fatigued staff may not adequately perceive risk, tolerating risks they would usually find unacceptable. Staff communication, monitoring and co-ordination activities are adversely affected by fatigue. People may be completely unaware of the extent to which their performance is being reduced by fatigue, and may be unaware of lapses in attention or even briefly "nodding off". Fatigue can be hard to detect in staff – unlike other causes of temporary mental impairment such as drugs and alcohol, there is no "blood test" for fatigue. These features make fatigue a particular concern in any safety critical work.

Fatigue has been cited as a significant contributory factor in serious high profile accidents in a wide range of industries, including nuclear power (Three Mile Island; Chernobyl), chemical manufacturing (Bhopal), the grounding of the tanker Exxon Valdez, the Challenger space shuttle disaster and the rail crash at Clapham Junction [4, 5, 6]. Addressing fatigue has been high on the US National Transportation Safety Board's "Most Wanted" list since 1990 [7].

Overall, fatigue makes dangerous and expensive mistakes more likely, reduces productivity and morale, and increases absenteeism [8, 9]. There are very sound financial, as well as legal and moral, reasons to manage fatigue properly.

Links with culture

Managing fatigue well can be difficult, and is often complicated by conflicting interests, industrial relations and cultural issues. Employers try to achieve safety in an efficient and profitable way. Staff and unions also want a safe operation, but may have their own, sometimes differing goals of reduced working hours, increased time off, increased pay and linked work/life balance issues. Hourly pay rates or similar payment schemes may inadvertently encourage staff to work longer hours than may be safe, and discourage staff from honestly reporting fatigue concerns. Staff may favour fewer, longer shifts than may be safe, so they can have longer blocks of time off. Pressure to keep train services running may place staff under great pressure to carry on working even if they feel too tired to work safely – they are unlikely to report feeling fatigued if the corporate or local culture means they perceive they will be punished rather than treated in a "just" way. Employers need to be able to trust staff to take personal responsibility for getting the sleep required to do their work safely, and to openly report any fatigue concerns.

It takes sustained effort, leadership and long term commitment to build and maintain a culture of trust regarding fatigue. Openness, honesty and collaboration are key. Collaborative working between management, staff and unions is essential for properly managing fatigue risks, and a joint fatigue action group with representatives from all parties, encourages trust and a common understanding of problems and possible solutions.

Recent GB experience in controlling rail staff fatigue

Recognising the risks from fatigue, safety regulators in various countries have attempted to improve fatigue controls in the industries they regulate [8], and Britain's rail industry is no exception. In addition to longstanding "hardware" aids such as the various vigilance devices designed to bring a train to a halt if the driver becomes inattentive, fatigue controls have generally taken the form of limits on hours worked, for instance maximum shift length, maximum hours worked per week. This prescriptive "duty hours" approach was refined in GB in 2006 when revised law (ROGS) advocated a more "goal-setting" approach to managing risks from fatigue. These regulations require rail companies to implement arrangements to ensure that no-one carrying out safety critical duties works when they are, or are liable to be, so fatigued that they could injure themselves or others. However, the regulations do not prescribe exactly how this goal must be achieved – companies can make whatever arrangements they choose, provided they effectively control risks from fatigue.

Following the introduction of the 2006 regulations, ORR found that some companies still struggled to understand exactly what was required of them, or found implementing fatigue controls in practice difficult.

During inspection work and discussions with companies, ORR found that some were still relying almost exclusively on simplistic company duty-hours limits. This "one size fits all" approach can be a blunt instrument - if the simplistic hours limit is set for the "worst case" of the most demanding or hazardous work, this is likely to be over-restrictive for many less demanding work situations, raising costs unnecessarily without significant risk control benefit. If the limit is set for less demanding work, it may fail to adequately control risks from fatigue in more demanding tasks/roles.

Other companies were trying to take a more progressive approach by using one or other fatigue tools – software packages designed to mathematically model some of the key factors which affect fatigue, such as length of work period, time of day/night, workload, breaks etc. However, some companies were over-reliant on the output of such tools, using them in isolation to decide whether a particular working pattern was likely to be "safe" or "unsafe" rather than as just one useful aid in such assessments. This was similar to recent findings elsewhere [10, 11, 12].

To help improve the industry's understanding and implementation of fatigue controls, ORR decided to produce revised fatigue guidance [13]. Experience from inspection of fatigue controls and discussions with rail managers, staff and unions were complemented by a review of recent fatigue literature in other industries and countries, though this cannot be claimed to be comprehensive as the field is vast and continually growing. Themes for the improved guidance were identified, and included:

- more detail overall on expected fatigue controls;
- consistency with wider safety management systems and the "Fatigue Risk Management System" being increasingly adopted in other industries;
- links between organisational culture and fatigue;
- avoiding over-reliance on prescriptive "hours of work" limits and fatigue assessment tools;
- fatigue from time spent travelling to, at or from work, and;
- managing fatigue through contractual chains.

Revised guidance was prepared, the industry consulted, and the revision published in January 2012 [13].

ORR GUIDANCE "MANAGING RAIL STAFF FATIGUE"

The revised good practice guidance is available on ORR's website. Although following the guidance is not compulsory, and companies are free to take other effective action, rail companies following the guidance will normally be doing enough to comply with fatigue aspects of GB health and safety law. Some key areas are now outlined.

A proportionate approach

It clearly makes sense for fatigue controls to be in proportion to the potential risks from fatigue, so the guidance emphasises a proportionate approach throughout. A "three-tier" approach is suggested, with the robustness of fatigue controls generally depending on the likely significance of risks from fatigue.

Type of work	Likely significance of risks from fatigue	Relevant sections of the guidance
No shift work, no significant overtime, no safety- critical work	Low	Basic fatigue controls (one page of guidance)
Some shift work and/or significant overtime but no safety-critical work	Medium to high	A comprehensive Fatigue Risk Management System
Safety critical work	High	Fatigue Risk Management System AND Safety-critical work controls

Figure 1. The suggested three-tier approach for using the guidance

Basic fatigue controls should suffice if there is no shift work or safety-critical work. Fatigue controls should be very robust for safety-critical work, where a fatigue-induced error could have catastrophic consequences for the rail system, and the section of the guidance covering safety critical work includes suggested good practice guidelines for working patterns based on previous research and experience across industries. Although these guidelines are not compulsory, ORR considers that the more a working pattern deviates from them, the greater the likely need to assess and control the potential risks from fatigue.

Triangulating fatigue

It was previously outlined how some companies were over-reliant on simplistic duty-hours limits whilst others were over-reliant on the outputs of a bio-mathematical fatigue tool. For instance ORR had encountered instances where staff had reported concerns about feeling too fatigued to work safely, but managers had dismissed these concerns on the grounds that a mathematical fatigue tool said they "shouldn't" be fatigued! The guidance seeks to correct this type of misunderstanding, by suggesting that, in isolation, no single method of assessing fatigue is likely to be satisfactory, and that a selection of methods and information sources is desirable which, between them, can help to "triangulate" the position on fatigue, as illustrated below.

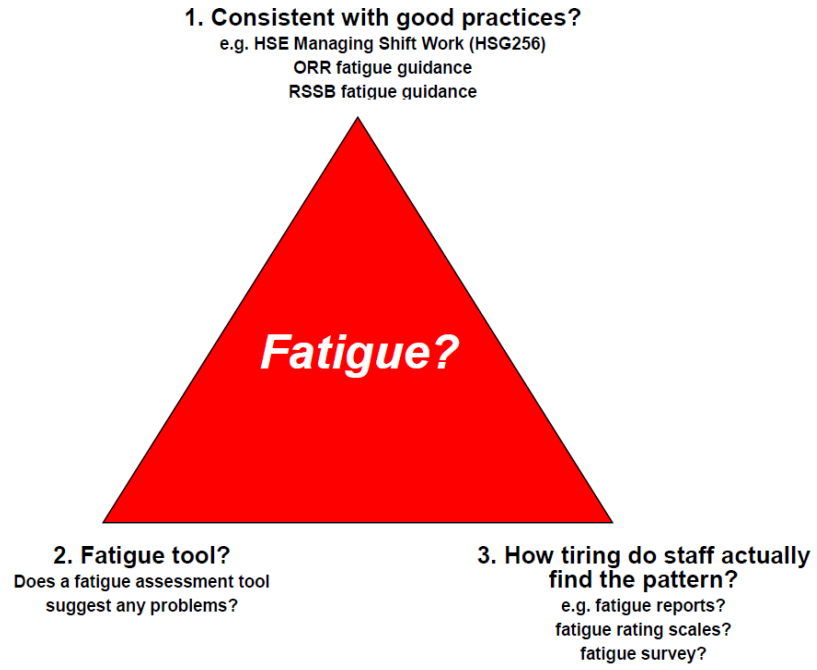

Figure 2. "Triangulating" fatigue

To "triangulate" the position on fatigue, it is suggested that:

- 1. Existing or proposed working patterns should be assessed against good fatigue management principles outlined in the guidance since, generally, the more a working pattern deviates from these, the greater the likely risk of fatigue.
- 2. The patterns may then be assessed using a fatigue assessment tool, to help identify any opportunities for further reducing fatigue risks. However, although such tools can help show likely trends and where "peaks" in average fatigue are likely to occur, it is important to be aware of their limitations, for instance:
    - they only provide a general indication of likely average fatigue, and cannot take into account the many individual factors which can make an individual more or less fatigued than a bio-mathematical model may suggest
    - In particular, many tools assume that staff get sufficient, quality sleep during off-duty periods, and do not take into account that staff may not have been able (or in some cases willing) to get the "assumed" amount of quality sleep. Hence the importance of devising fatigue-friendly working patterns which allow adequate sleep opportunity, of personal accountability, education in sleep hygiene, and a "just" culture which encourages openness about any fatigue problems
- 3. General principles and fatigue assessment tools are not perfect – it is important to carry out a "reality check" by seeking feedback from staff about how tiring the working pattern is in reality, and seeking other indicators of likely fatigue.

Fatigue Risk Management Systems

The guidance advocates that if staff work shifts or do significant overtime, a comprehensive Fatigue Risk Management System (FRMS) should be developed. An FRMS approach is increasingly being adopted in other progressive high hazard industries, notably civil aviation. An FRMS identifies and draws together all the preventive and protective measures which help an organisation control risks from fatigue. It should be based on a comprehensive understanding of fatigue, managing fatigue in a flexible way which is appropriate to the risk and nature of the operation. An FRMS should as far as possible:

- Be based on sound fatigue control principles rather than custom and practice;
- Take account of fatigue information collected about the organisation's own operations and feedback from staff, tailoring fatigue controls accordingly;
- Be integrated with the company's wider safety management systems;
- Be a continuous, adaptive process, continuously monitoring and managing fatigue risks, whatever their causes.

Adopting an FRMS approach has several advantages [14], including improved safety, improved staff morale, reduced absenteeism, competitive advantage, and future-proofing against changes in legislation. An FRMS uses several layers of defence to prevent fatigue and fatigue-induced errors from developing into incidents or accidents. Different regulators and fatigue specialists worldwide have set out what they think are the essential elements of an FRMS. ORR's guidance summarises what we believe are key features from these various FRMS interpretations, and puts them into the "POPMAR" risk management structure widely used for many years by larger GB employers, including many rail companies.

The "POPMAR" approach to managing fatigue risks

The GB Health and Safety Executive published guidance on *Successful Health and Safety Management* in 1997 [15] and since than many GB employers have found the "POPMAR" risk management cycle which it outlines useful in structuring their risk management systems. The POPMAR acronym here is taken from the

stages in the repeating cycle: Policy; Organising; Planning & implementing; Measuring; Auditing and Reviewing.

Figure 3. The "POPMAR" risk management cycle

ORR's fatigue guidance simply outlines fatigue considerations under each stage of the POPMAR cycle. The guidance recognises that rather than existing in isolation as a "stand-alone" FRMS, fatigue controls will be dispersed throughout - integrated into - wider risk management systems. Some suggested components of an FRMS are summarised, with suggestions on what ORR considers reasonable approaches. Broad headings are summarised in condensed form in **Appendix 1.**

An FRMS checklist

Based on the POPMAR structure, a suggested checklist is provided in the ORR guidance, to help both companies and the regulator assess the adequacy of existing fatigue controls. The checklist helps to systematically compile a "signposting" document identifying existing fatigue controls in dispersed risk management systems, and any gaps where consideration of further controls may be needed. Once again a proportionate approach is advocated, stressing that, depending on the nature of the operation and the potential risks, not all elements will be relevant to all operations. A condensed summary of the checklist can be found at Appendix 1.

CONCLUSION

Fatigue is likely to remain a significant issue for rail organisations to manage. This paper has outlined some features of the GB safety regulator's guidance on managing rail staff fatigue, with controls proportionate to likely risk. Some key elements of a holistic "Fatigue Risk Management System" have been outlined, and the use of a checklist has been suggested, to compile a "signposting" document which helps identify existing fatigue controls, and any gaps. "Triangulating" the position on fatigue helps companies assess likely fatigue risks by combining published good practice guidelines, the use of a fatigue tool, and information about how fatiguing staff find their working patterns in reality.

The central importance of an open, trusting, "just" culture has been emphasised, with strong leadership demonstrating a commitment to openness, trust and honesty, and collaborative working on fatigue improvements between employer, staff and unions.

The FRMS checklist in ORR's guidance may be a useful starting point for companies wishing to review their fatigue controls and evolve their working patterns and fatigue controls over the medium to longer term.

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APPENDIX 1.

FATIGUE IN THE "POPMAR" RISK MANAGEMENT CYCLE

"POPMAR" stage	Fatigue considerations
Policy	• Policy on controlling fatigue? • Leadership on fatigue, ongoing commitment to resourcing FRMS? • Collaborative approach, links to culture acknowledged? • Links between resources, workloads, fatigue & stress recognised?
Organising	• Fatigue roles & responsibilities clear? • Joint group for management/staff fatigue collaboration considered? • Fatigue risk assessment expectations clear? • Fatigue effects of staffing levels & work demands assessed? • Contingency arrangements for abnormal, degraded & emergency work? • Employment Terms & Conditions, payment systems "fatigue-friendly? • Overtime, shift-exchange, on-call, sickness absence arrangements? • Co-operation on fatigue with other companies? • Contract award & monitoring arrangements control fatigue? • Fatigue reporting encouraged, easy and understood, "just" culture? • Fatigue education & awareness for staff, supervisors, managers? • Detect, correct & mitigate fatigue-induced errors? Hardware & people solutions? • Arrangements for controlling time spent travelling to, at and from work?
Planning & implementing	• Structured process for planning & designing work patterns? • Work planning process considers good practices, fatigue tool and staff feedback ("triangulating" fatigue)? • Fatigue in staff medical fitness & selection? • Accurate shift start & end times and travel times? • Requirement to declare any "second jobs" and assess fatigue from them? • Fitness-for-duty checks consider likelihood of fatigue for whole shift? • Fatigue improvement plans for short, medium, longer term?
Measuring	• Deviations from planned work patterns monitored? • Deviations from published good fatigue practices monitored? • Fatigue tool used to assess actual (not just planned) work patterns? • Fatigue reports monitored, actioned and feedback provided? • Staff experiences on fatigue sought e.g. fatigue survey, rating scales? • Fatigue considered during incident & near-miss investigations?

	• Trends in shift exchange, overtime, sickness absence monitored? • Other data sources monitored for fatigue clues e.g. train delays, irregular working? • More progressive measurement/monitoring considered where appropriate e.g. On Train Data Recorders ("black-box") role? Sleep logbooks? Actigraphs (sleep wristband monitors)?
Auditing & Reviewing	• FRMS effectiveness evaluated periodically & after significant incidents/near-misses/concerns? • Are Key Performance Indicators for fatigue established and performance tracked? • Fatigue audit, independent review arrangements? • Fatigue audit & review findings fed back into FRMS controls? • Findings of fatigue audit & review publicised to staff to encourage involvement?
General	• Fatigue controls integrated with wider risk management systems? • Fatigue controls proportionate to operation's nature, size, risks? • Are dispersed fatigue controls identified and drawn together via a "signposting" FRMS document?

APPENDIX 2:

APPROVAL TO PUBLISH PAPER

I...Jeremy Mawhood.....

of Office of Rail Regulation.....

hereby give permission to the International Railway Safety Conference 2012 (IRSC 2012) to publish the paper titled:

RAIL STAFF FATIGUE – THE GB REGULATOR'S PERSPECTIVE ON MANAGING THE RISKS.....

To be presented at the IRSC 2012 conference to be held at the St Pancras Renaissance Hotel, London, England on 8 - 12 October 2012.

In the following media (tick as appropriate):

☐ Copied to memory stick for distribution to conference delegates

☐ Publish on the IRSC 2012 website

Signed: .....JA Mawhood.....

Date: .....2 August 2012.....

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