Lessons learnt from introducing a Fatigue Risk Management System

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SUMMARY

Fatigue has long been known as a risk to safe human performance across many industries, in the UK. However, in 2019, it had not been considered as a risk factor within the gas distribution network industry. This paper summarises some of the work that has taken place so far to implement a Fatigue Risk Management System into an organisation and begins to reflect on what worked well and what needed reflecting upon and revising.

KEYWORDS

Fatigue, Gas, Emergency, Distribution

Introduction

The gas distribution industry was privatised in 1986 and there are now four gas distribution networks in Great Britain (Ofgem, 2018). There are 22 million homes and businesses linked to the gas networks and the gas distribution networks transport the gas from coast to meters. This network of pipelines requires continuous repair and maintenance to ensure gas is constantly supplied to those who need it. As well as repairing and maintaining the 284,000 km of pipeline networks, the gas distribution network's engineers are responsible for the safety critical tasks of attending gas emergencies, such as gas leaks, low gas pressure, or no gas pressure, which means the workforce operates 24 hours a day, every day of the year.

Fatigue is defined, by the Health and Safety Executive as: "The decline in mental and/or physical performance that results from prolonged exertion, lack of quality sleep or disruption of the internal body clock," (Health and Safety Executive, 2006). The effects of fatigue worsen the longer someone is awake and people are, often, not aware that they might be fatigued (Dawson & Reid, 1997; University of Oxford, 2010; QinetiQ Centre for Human Sciences & Simon Folkard Associates Limited, 2006). Fatigue can compromise safety due to a number of impairments, including: impaired decision making, higher level of risk taking, poorer vigilance, poorer coordination and poorer communication, as well as causing long term health conditions (Olorunnisola, 2022). Therefore, effective fatigue risk management is required to keep gas engineers, and the public, safe.

The gas distribution industry was instructed by the Health and Safety Executive that it was their responsibility to manage fatigue risk amongst all their employees, particularly those who undertake safety critical duties. The gas distribution network put a cap of 16 working hours a day in place, with the ambition to cut that to 12 hours, over time. The 16 hours working, incorporates standby working time, which includes periods of not working, as well as periods of being called out to attend emergencies, out of hours.

In 2019, 14 safety critical engineers were interviewed about the work they do and the way in which they perceived fatigue being managed. The opinion, at that time was there were no resources to relieve them if they were tired and that the processes in place were tick box exercises, which led to no action. In addition, 400 gas engineers responded to a fatigue survey where 15% of respondents reported working over 16 hours more than once a week and 37% had reported working over 16 hours once or twice a month. At that time, the data did not show actual working hours. But, by August 2021, the way in which working hours were monitored had improved, and the data was showing that the percentage of people working over 16 hours during a one-month period and was showing as 0.005% of 44000 shifts. There is no comparable data, except the interviews and surveys from this time, but it is perceived to be a good news story that the 16-hour cap was being adhered to and breaches of 16 hours working were rare occurrences that were investigated and discussed.

In 2023, a Knowledge Transfer Partnership was established between the University of Nottingham and the gas distribution networks. This began with interviewing 21 engineers across three of the gas distribution networks and some of the engineers did speak positively about the fatigue assessments that are in place now. This data is not directly comparable to the previous interviews that were from only one gas distribution network, and there was still some negativity. However, there is hope that the current improvements to the fatigue assessments are beginning to have a positive impact and that further work will increase positive perceptions in the future.

There is still a way to go for the implementation of fatigue risk management within the gas distribution industry. This is a continual process of implementation, evaluation, and evolution. It is hoped that sharing the processes that this industry has implemented so far may be valuable to other industries that are beginning to implement their own fatigue risk management systems.

Implementation

To obtain a hard stop at 16 hours, several measures were put into place. A summary of implementation and lessons learnt are presented and discussed below.

Fatigue Risk Management System

The first thing that was introduced was the concept of the Fatigue Risk Management System. This was first included in the Fatigue Risk Management procedure, to demonstrate the framework that should be adopted for every fatigue process or tool that is implemented. It was based on the Fatigue Risk Management cycle found in the Office of Rail Regulation's fatigue guidance (Office of Rail Regulation, 2012).

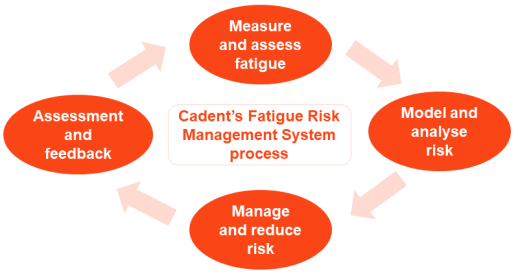

Figure 1: The Fatigue Risk Management System cycle diagram

Figure 1 shows how the cycle is displayed in the organisation's fatigue procedure. One challenge with this cycle, is that people felt that the name implied that this would be some form of software or actual tool, rather than a form of framework to be followed for the implementation of fatigue work,

tools, and processes. More explanation was required to demonstrate what it was and how it should be used.

In addition, the part of the cycle that is consistently the hardest to carry out is the evaluation and gaining feedback. This is something that the industry is continually trying to improve. Some methods that have helped are to ensure that a wide range of representatives across the business are part of the fatigue working group, in order that they can feed back how it is affecting their areas. In addition, including trade unions is crucial to understand the impact that changes are having on their members.

One, important way in which information was collected on how effectively things were being implemented, was via the work pattern design process. Understanding how differences arose between managers and employees and trade unions was crucial to addressing these challenges and for finding and developing solutions, as discussed in later sections of this paper.

One learning from this, is to find ways to strengthen the message that changes cannot be made and then forgotten, because there is a feeling that fatigue management is complete. It is essential to continuously review the changes and reflect on how best to make further improvements, where necessary.

Fatigue Risk Index Calculator

The Fatigue Risk Index Calculator is the Health and Safety Executive's tool for calculating the fatigue and risk attached to work patterns (QinetiQ Centre for Human Sciences & Simon Folkard Associates Limited, 2006). The Karolinska Sleepiness Scale is a self-report scale that measures the level of sleepiness that users are feeling at the time of day that it is being used (Shahid, Wilkinson, Macu, & Shapiro, 2012)

The Fatigue Risk Index Calculator allows users to put in shift patterns and then calculates an average fatigue index score and an average risk index score. The fatigue index score ranges from 0 to 100 and indicates the percentage chance of obtaining a high score (for example, 8 or 9) on the Karolinska Sleepiness Scale. This high score is predictive of an individual working that pattern, having a high chance of experiencing microsleeps. For example, a fatigue index of 50 would mean a 50% chance of scoring a high score on the Karolinska Sleepiness Scale. The risk index indicates the probability that a person working that pattern has of having a fatigue related incident. So, a risk index of 2 would be indicative of doubling that risk. A pattern formed of four 12-hour shifts, consisting of two-day shifts, two-night shifts and four rest days would have a fatigue index of 20.7 and a risk index of 1.

Initially, with no clear guidance or understanding of how to manage fatigue risk within the organisation, clear and simple tools were required. The Fatigue Risk Index Calculator was adopted as the first tool used to help the work pattern analysts design work patterns that managed fatigue risk. Exploring other industries was key here, to understand what numbers they should reach in both the fatigue and the risk indices. These indices should not be used in isolation and any targets set should be calculated based on existing patterns. However, the ambition was to move from shifts of 16 hours to 12 hours, so the targets were set to get these indices as low as reasonably practicable with a target of a maximum fatigue index of 30 and a maximum risk index of 1.5.

This worked well for a high-level overview of work patterns, and acted as an indication of where they were. These were introduced with a number of examples of recommended good practice within the work patterns, which gradually increased. However, setting targets did not work well because they led people to design work patterns that the engineers did not wish to work. The engineers did not understand why their patterns had to change and were unhappy that they had. It also led to disagreements between trade unions, management, and work pattern analysts, because of the

conflict between their understanding of good work pattern design and between the different things they wanted.

The organisation is now moving towards introducing more recommended good practice and work pattern design principles. These, in line with the Fatigue Risk Management System, will be reviewed to ensure that they are in line with recent research. Sound work pattern design principles reduce misunderstandings, conflict, and introduce a clear framework with which people can work together to design fatigue compliant work patterns. To further help with the understanding of these principles, a guide explaining why these principles have been applied alongside the research behind them, has been produced to demonstrate why they are important.

Finally, the Gas Distribution Networks have begun working with the University of Nottingham in a Knowledge Transfer Partnership. A graduate is working to deliver several literature reviews in a range of different areas, and these will further inform the Work Pattern Principles in the future.

As a guide, some of the Work Pattern Principles included in the first draft of the guide are listed below. It is expected that the list of principles will evolve and grow over time, particularly as the Knowledge Transfer Partnership graduate releases findings from their literature reviews. The list below have been compiled from the Working Time Directive and the Health and Safety Executive's Managing Shiftwork (UK Government, 1998; Health and Safety Executive, 2006):

- Limit working during night hours (between 11pm and 6am) to eight to ten hours.
- Night shifts should be followed by a minimum of two nights rest.
- Two days rest in every fourteen days.
- Maximum number of consecutive days worked should be seven.
- Nighttime shifts that are over 8 hours long, limited to three consecutive days.
- Nighttime shifts that are under 8 hours long, limited to five consecutive days.
- Eleven consecutive hours rest.
- Work patterns follow a forward rotating pattern (e.g. from day shifts to afternoon shifts to night shifts).
- Rotate shifts quicky (e.g. every two to five days).

Fatigue Education

A mandatory e-learning was set up for all staff within the organisation. The e-learning covered a range of topics, including:

- Defining fatigue.
- Understanding the circadian rhythm.
- Understanding the causes of fatigue – showing work factors are a part of it, along with individual factors and environmental factors.
- The symptoms of fatigue.
- The health impact of fatigue.
- How to manage fatigue.
- Tips on good sleep hygiene.
- A summary of what the Gas Distribution Networks are doing to help manage fatigue.

The e-learning included different learning materials, including animated videos, electronic card sorting, quizzes and videos from key stakeholders connected to fatigue within the organisation.

A pilot of the e-learning took place with a small group of people, and they gave honest, but positive, reviews. However, feedback from those taking part mentioned the feeling of fatigue from the perception that they were always doing e-learning and it gave the feeling of another thing to do. It

became apparent, during conversations that learning from the e-learning also did not seem to stick for long, despite the quizzes throughout and the varied style of learning. The organisation is now working towards communications (e.g. bitesize learnings in company briefings) and threading learning through other training courses. For example, a section on fatigue was included in the company induction, alongside internal fatigue web pages that provide information on fatigue.

Further training was also required for key employees who carried out duties in relation to fatigue. For example, fatigue assessors and managers. This is currently under review to ensure the right people are receiving the right information.

In addition, a learning channel was compiled, which listed information about fatigue and included links to other resources including books, podcasts, websites, and videos that employees could refer to if they wanted to learn more.

Fatigue Assessments

Fatigue assessments were created to assess how fatigued engineers were when they worked over 11 or 14 hours, to stop the engineer from working over 16 hours or to stop them from working when fatigued. Several versions of these assessments have been used. The first versions relied upon asking the engineer how they felt and if they felt fatigued, whilst also asking fatigue assessors if they could hear signs of fatigue or if supervisors could visibly spot signs of fatigue (such as yawning or irritability). However, people are not always aware that they are fatigued, particularly when they are focused on completing a task (QinetiQ Centre for Human Sciences & Simon Folkard Associates Limited, 2006).

The latest version has become more objective because people do not know when they are fatigued (Dawson & Reid, 1997). It focuses on how many hours the individual has worked that day and over the preceding days. This also includes the Karolinska Sleepiness Scale, so that engineers can rate their own sleepiness. The first challenge was that the industry did not accept that long hours necessarily lead to an increased fatigue risk. Particularly, when engineers were telling everyone that they did not feel fatigued. This stems from a lack of understanding about fatigue, its effects and the way in which people may not feel particularly tired or notice that they do. This is gradually being addressed with more training and information to increase understanding of how fatigue may affect people.

In addition, the feedback was that the assessment now feels too much like a tick box exercise and engineers are failing to see the importance of the assessment, whilst the assessors are not finding it as easy to have a conversation, as they were before. Work is now taking place to see how these assessments can be carried out in a more conversational and friendly way, whilst still being able to collect the relevant information that will inform assessors of the engineer's fatigue levels.

Conclusion

For ease, a summary of learnings from the above topics have been included below.

Fatigue Risk Management System

An effective fatigue risk management system allows an organisation to implement changes and then to reflect on the impact they have had, before deciding how to improve upon those changes, if necessary.

Focus should be on how something can be evaluated at the point that it is implemented.

Fatigue Risk Index Calculator

Explaining why work pattern principles are important is crucial. As is explaining, them simply and clearly, with no ambiguity, so that they can be followed consistently.

The Fatigue Risk Index is a useful guide to see what works and what does not, but it needs to be used alongside a good knowledge of recommended good practice around work pattern design principles.

Fatigue Education

It may feel like the best course of action is to introduce one training course that will teach everything they want to know. However, it is important to understand that one course is not going to immediately equip everyone with the required knowledge.

Tailor training for individual roles, using training needs analysis. Who are they? What do they need to know about fatigue? How will they use this knowledge in their role?

Back up the training with online resources that people can access at any time.

Tie fatigue communications with key events in the organisation's and, the national calendar, with events like lunch and learns, short videos or safety moments that managers can pick up and use in team briefings.

Fatigue Assessments

These have been challenging to create.

Objective measures are considered most effective for measuring fatigue levels. But it is important that those carrying out the assessments understand the effects that long hours can have. There should be an understanding that we are safe to assume that long hours worked do equal fatigue.

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