

Is It Really Worth Asking The Users? A Case Study from the Rail Industry

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Abstract. As part of a musculoskeletal disorder (MSD) risk management programme, Southeastern Railway conducted a questionnaire survey to gather information from their drivers to complement physical ergonomics data and task analysis information. This paper discusses the reasons behind this approach, the design of the questionnaire, the survey distribution and collection and reflects on the information gathered; ultimately considering the question of whether the effort was worthwhile.

Keywords. Questionnaire, Survey, User

1. Introduction

Southeastern operates train services into London from Kent and East Sussex, managing 166 stations and serving 176 stations. Southeastern have held the Integrated Kent Franchise (IKF) since 2006 with 70% of customers being commuters. The company runs services into five London termini (Charing Cross, Victoria, Cannon Street, Blackfriars and St Pancras). The scale of operations includes running 1,922 passenger trains on weekdays, 1,690 on Saturdays and 968 on Sundays. The company delivers around 640,000 passenger journeys every weekday, making it one of the most heavily used Train Operating Companies in the UK. Southeastern operates 12 train crew depots and employs around 1000 train drivers. They drive a total of 367 trains from nine different fleet types, each featuring various cab designs and different ergonomic challenges. Mainline trains operate throughout Kent using Bombardier Class 375 Electrostars dating from 2000, Metro trains on the inner London routes using Class 465 and 466 Networkers dating from 1992 and Class 376 Electrostars dating from 2005, with High Speed trains from Kent to St Pancras using Hitachi-Class 395 trains, the newest trains on the network introduced in 2009.

2. The MSD Programme

Train drivers are exposed to risk of discomfort and injury for a variety of reasons including:

- Exposure to poor fit, working in cabs which have not traditionally successfully benefited from good application of anthropometry.
- The application of excessive forces to hand and foot controls.
- Their task is predominantly sedentary which encourages static muscular loading, exacerbated at times by the need to adopt non-neutral postures.

Recognising that the management of MSD risks requires a holistic, ergonomics-based approach, Southeastern determined to implement a programme which was based on a full understanding of the risks, their controls and the complimentary policies and procedures.

Working with the ergonomics consultancy, David Hitchcock Limited, they embarked on an investigation of the four risk factor groups; cab fit, driving task, individual factors and psychosocial.

‘Cab Fit’ was concerned with the anthropometry of reach and clearance to accommodate the different sizes of drivers. The ‘Driving Task’ focused on posture, movement and repetitiveness. ‘Individual Factors’ addressed the impact of issues such as pre-existing medical conditions and experience. ‘Psychosocial’ particularly concentrated on driver’s opinions of their working conditions and arrangements.

These four groups are not independent – for example, anecdotally, some drivers who, according to the anthropometry data do not fit the cab express no concerns about being cramped or needing to overreach. In addition, through stress and changes of behavior, psychosocial factors can lead to MSD, so both the physical and psychosocial factors need to be identified and controlled (HSE, 2002).

It is also good practice for investigations of this nature, where subjectivity plays a significant part, to use two or more sources of data to validate the findings. So, in addition to the physical measurement of cab sizes and the forces required to operate controls, consultation with the drivers – the primary users – is typically recommended.

3. Driver consultation

Some workgroups offer easy access to consultation opportunities, but a driver workforce is more complex. They work on a shift system, starting and finishing from different geographical areas. It would be unrealistic and prohibitively expensive for interviewers to try and engage directly with each and every driver. And although distribution of questionnaires to each drivers with other paperwork they regularly need to collect would be relatively straightforward, it would be very difficult to chase and collect completed questionnaires to generate a decent return rate. Similarly, online survey methods would not give access to every driver, particularly in work time.

Considering these, Southeastern elected to produce a comprehensive yet concise, easy to complete paper questionnaire which could be completed ‘there and then’ (in under 15 minutes even with extensive free text responses) as part of the Learning and Development Days (LADD) which provide six monthly briefings on safety and operational matters.

To encourage a good response rate, the questionnaire was intentionally specified to be for ‘DRIVERS’. Acknowledging that the MSD issue was an emotive one which tended to focus individual drivers’ attention on the seat, the foot pedal or the hand controls according to where they felt particular discomfort, the questionnaire was titled as an ‘ERGONOMICS SURVEY’ which enabled the whole range of potential risk factors to be considered. Finally, in an attempt to seek honest responses, the respondents were assured that their responses were anonymous.

4. Questionnaire returns

506 questionnaires were returned from 960 train drivers who attended the LADD events in Autumn 2014. This return of 53% is higher than the results for other comparable internal surveys completed by Southeastern with an average return of around 30%. In a review of 490 surveys, Baruch and Holtom (2008) found that the average response rate for studies using data collected from individuals was 52.7% with a standard deviation of 20.4.

5. How did the survey fit in?

Five different cabs were considered, which according to the measurements for reach, clearance and the operation of controls indicated that several dimensions may not be sufficient to accommodate the range of 5th percentile female – 95th percentile male drivers (based on the anthropometric data of Peoplesize (Open Ergonomics, 2008)) :

Table 1: Cab Dimension Shortfalls in Accommodating Full Range of Driver Sizes

Dimension	Cab 1	Cab 2	Cab 3	Cab 4	Cab 5
Clearance beneath desk	✓			✓	✓
Force to operate foot control	✓	✓	✓	✓	✓
Seat armrest height	✓	✓	✓	✓	✓
Seat height adjustment range	✓		✓	✓	✓
Seat lumbar height	✓	✓	✓	✓	✓
Seat pan depth			✓	✓	✓

In an of itself, this is not necessarily an unusual collection of findings; the Railway Safety & Standards Board (RSSB) had previously reported a general problem across the industry of compromised driver fit within cabs (RSSB, 2008).

It does however create a significant problem. Engineering (e.g. knee clearance beneath fixed, integrated desks), safety (e.g. inadvertent operation of controls) and financial constraints may mean that physical changes to improve fit in existing cabs may not be possible. Nevertheless, in a traditionally engineering-based industry, objective data of this nature is highly regarded and can be regarded as ‘pass’ or ‘fail’. This creates an inevitable conundrum and a sense of vulnerability to the management of risk and the perceived health of drivers. Anecdotally, a knee-jerk response to change what can be changed is adopted which proves to be ineffective. For example, providing lumbar cushions to improve lumbar support may have compromised effect if drivers are not prepared to carry them from one cab to another.

A more considered approach is necessary. To gain a clearer understanding of the issues may be achieved through task analysis. In this instance, this was conducted by ergonomists using a variety of established MSD task assessment tools, most notably the Musculoskeletal risk Assessment for Train Drivers (RSSB, 2012) which integrates techniques such as the Assessment of Repetitive Tasks (HSE, 2010). A small sample of task analyses for the five cab types, revealed two particularly significant findings:

- Lower limbs are held in static postures which effectively reduces circulation, increases fatigue and may lead to discomfort and heightened risk of musculoskeletal injury.
- Drivers do not consistently adopt a neutral driving posture, or one that always reflects the typical static anthropometry positions against which the physical comparisons for cab fit are determined.

These two findings suggested a number of critical issues regarding the MSD programme:

1. The physical cab-fit issues did not tell the whole story regarding risk.
2. Making changes to cabs based on anthropometric measurements would not necessarily lead to the most important improvements, not least because driver postures were so varied.

3. The driving tasks were also highly varied, effected not only by individual driving styles but also factors such as route types and the opportunities to regularly alter posture, controls size, cab state-of repair and cleanliness and driver information and training regarding posture and movement risks.

It followed that consultation through invitation to all drivers to participate was required to more fully understand the active risk factors and to consider the individual and psychosocial factors. This would enable triangulation; the investigative technique of using two or more sources of information previously mentioned. The most time and cost-effective approach to this was through the driver survey. A simplified overview of the common findings are summarised in Table 2.

Table 2: Summary Findings of Survey

Issues of Potential Concern	Cab 1	Cab 2	Cab 3	Cab 4	Cab 5
General cab fit	✓	✓		✓	✓
Cab seat	✓	✓	✓	✓	✓
Foot control	✓	✓		✓	✓
Awkward movements	✓	✓	✓	✓	✓
Most prevalent body area of pain	Back	Bottom		Back	Back

The survey consolidated these headline findings with the details behind the concerns, which when compared with the other information sources enabled key issues to be confirmed and clarified; for example:

- The seat issues identified through the cab measurements were the same as those resulting in driver concerns. The task analyses, however, also showed that problems were not exclusively the result of poor fit, but also because drivers did not always adjust the seat to the best fit and position for their body in relation to the cab controls.
- Foot control design (shape, size, position, orientation and force) had a strong influence on driver posture, particularly the lower limbs. This was evident from the task analyses and the survey.
- Similarly, it was the task analyses, and in particular the survey which highlighted other MSD risk factors not considered in the cab physical measurements. For example, frequent trunk twisting and excessive upper limb effort to open the left cab window so that the driver could ‘look back’ when at a platform.

6. Was the survey worth it?

Preparing a questionnaire is time-consuming, including the need to pilot the questions and format. Collection of responses and the analysis of the findings can also demand considerable effort; as indeed does the data entry from paper-based questionnaires. As such, the consultation exercise is more demanding than the measurement or even the sample of task analyses. So, the question of its benefits has to be raised.

In this case study, reflecting the type of benefits of user involvement described by Damodaran (1996) such as better understanding if the issues and avoidance of unnecessary design features, there was very clear evidence that the consultation revealed issues not identified through the physical measurement and application of anthropometry data. It was also clear that the consultation helped clarify factors identified through the task analyses.

This is reflected in the resultant actions considered by Southeastern Railway which included:

- Design improvements to the foot controls.
- Provision of driver training and information in cab set-up, posture, movement and MSD risk controls.
- Review of cab maintenance procedures.
- Strategy for future cab provision to accommodate the full range of driver sizes.

Conversely, there was also evidence that the user consultation alone would not have provided the level of detail necessary to quantify the extent of the physical shortfalls and therefore accurately and efficiently develop solutions. For example, in the case of Cab type 1, to accommodate the 5th percentile driver the seat should be adjustable 40mm lower than the current provision. This offers a far more useful insight than a driver's report of, "The seat doesn't fit me"! It was also clear that drivers' suggestions for cab improvement were highly varied, and understandably somewhat personal. Influenced by the individual respondent's requirements. Having the complimentary information from the other investigative sources undoubtedly added confidence and evidence to help sift decisions from ideas. Eason (1995) commented that when users are directly involved in the design process, the ergonomist has a role to help the user establish what is in their best interests. User involvement needs to be in context (Truman & Raine, 2001); the measurements and task understanding provided this to the survey design and consultation process.

Southeastern has valued the use the questionnaire, as it has been an opportunity to engage directly with train drivers on cab ergonomics and seat design. This has been regarded of great value given drivers within the business have regularly raised such issues and concerns previously at other forums.

It is also regarded as equally important for the business to be able to use the questionnaire to provide a data output that was useable to inform the decision making of Southeastern on the most effective immediate actions to take following completion of the ergonomic study.

As such the outputs from the survey have greatly helped to ensure prioritization has been given by Southeastern to specific actions, such as focusing upon the maintenance regimes in place for cab side window opening mechanisms and maintaining safety device foot pedal spring pressure, that enable the business to start addressing repeated observations raised by drivers through the questionnaire and also provide tangible ergonomic benefits to address concerns noted in other aspects of the ergonomic study.

7. Conclusion

MSD management requires a multi-factorial approach. Ergonomics has always offered such an approach and this case study supports the need to consider the core factor groups of user needs, workplace provision and task design. It also serves to remind those tempted by the attractions of computer modelling, rendering and the sole application of data sources that user consultation as a form of evidence is a vital element to understanding and prioritising solutions that should, therefore, prove effective.

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