Institution: University of Strathclyde

Unit of Assessment: 4

Title of case study: Improved railway safety through the implementation of a confidential incident reporting and analysis system (CIRAS)

1. Summary of the impact (indicative maximum 100 words)

The Confidential Incident Reporting and Analysis System (CIRAS), was developed in response to concerns about the role of human error in UK railway accidents. In 2008, CIRAS became an independently operated unit within the Rail Safety and Standards Board and is now available to everyone working in the UK rail industry; it codes reports about health and safety concerns and then facilitates a resolution between the individual and the relevant company or companies. 2.75 million passengers and 400,000 tonnes of freight use the railways in Great Britain every day and CIRAS impacts on the safety of all railway staff and passengers by ensuring that there are no barriers to reporting and resolving potential problems and hazards. It has also led to the construction of a database allowing safety issues to be classified and resolved before they can occur. Between 2008 and 2012 CIRAS received 2228 reports; 45% of these resulted in tangible safety improvements and approximately 33% contained important information about safety that was new to the company concerned. CIRAS has directly influenced the development of a confidential reporting system used in the USA.

2. Underpinning research (indicative maximum 500 words)

Context: Rail crashes such as those that happened at Potters Bar, Hatfield, Ladbroke Grove and Southall cost hundreds of lives. Following the Greenock rail crash in 1994, Scotrail set about investigating ways to improve rail safety. A report, commissioned by Scotrail, showed that many unsafe incidents were associated with human factors and human error. Subsequently, Scotrail awarded a grant to Professor John Davies at the University of Strathclyde's Centre for Applied Social Psychology to undertake research into the role of human factors in near misses, accidents and incidents on the railway network. A key problem that had been identified initially by Scotrail was the number of signals passed at danger (SPADs), which had been identified as contributing to many of the crashes and near-miss situations.

Key findings: The Strathclyde team undertook a series of laboratory-based studies on the subjective experiences and attentional lapses that occur during sustained attention tasks [1, 2] and this work gave the team insights into why SPADs may occur and the conditions for drivers that were more likely to lead to errors in train operation. However, from the data in a qualitative study where the team asked train drivers about SPADs [3], a further problem became apparent: detrimental working conditions were not being reported. This led Professor Davies' group to taking a new approach to assessing human factors in railway accidents. Previous approaches to accident prevention and safety had tended to focus on technical fixes rather than looking at the role of human input. However, the Strathclyde team's research indicated that, while staff were often aware of dangers and hazardous situations and practices, they were sometimes reluctant to report them, for fear of being implicated or because of the pressure to meet targets or reduce costs. In addition, the sheer number of different kinds of errors meant that a robust method of classification was needed to analyse and address problems at their source, rather than dealing with the symptoms. The Strathclyde team's studies led to the identification of the factors that prevented people from reporting safety issues [3], and they then used hermeneutics, in which the verbal accounts of drivers were analysed, to develop a taxonomical classification system. This method of classifying reports provided detailed analyses of the frequency and seriousness of different problems [4]. From this work, the team then developed a method for a confidential reporting system (CIRAS) [5, 6]. The system works by taking written or verbal reports of issues and incidents and coding them using the event coding model [6] developed by Professor Davies' team. The taxonomy is unique to this system and the power of the system increases the more it is used, as the data help to define specific error types. This makes problem solving more straightforward, since it can be seen that, for example, two problems are linked by a single underlying cause. Additionally, the confidential (but not anonymous) nature of the system meant that people would be more willing to report issues, even in a working climate that was sometimes characterised by fear and mistrust (in both directions) between rail workers and management. Initial evaluation of the system showed that it was picking up some serious and critical safety issues that had not been identified using standard

safety management practices [6].

Key Researchers: Professor John Davies, Professor in the Centre for Applied Social Psychology at the University of Strathclyde at time of research (2000-2006) led the research team comprising Alastair Ross, Research Fellow 1997 to 2011, Brendan Wallace, Research Fellow 2000 to 2004 and Linda Wright, Research Fellow 1995 – 2001.

3. References to the research (indicative maximum of six references)

1. Smallwood, J., Davies, J. B., Heim, D., Finnigan, F., Sudberry, M., O'Connor, R., & Obonsawin, M. (2004). Subjective experience and the attentional lapse: Task engagement and disengagement during sustained attention. *Consciousness and Cognition, 13*(4), 657-690. doi: 10.1016/j.concog.2004.06.003. **Note on quality:** This peer reviewed journal has an impact factor of 2.03.
2. Smallwood, J., Riby, L., Heim, D., & Davies, J. B. (2006). Encoding during the attentional lapse: Accuracy of encoding during the semantic sustained attention to response task. *Consciousness and Cognition, 15*(1), 218-231. doi: 10.1016/j.concog.2005.03.003. **Note on quality:** same as 1.
3. Ross, A. J., Davies, J. B., & Plunkett, M. (2005). Reliable qualitative data for safety and risk management. *Process Safety and Environmental Protection, 83*(B2), 117-121. doi: 10.1205/psep.04239. **Note on quality:** This peer reviewed journal has an impact factor 1.49.
4. Wallace, B., Ross, A., & Davies, J. B. (2003). Applied hermeneutics and qualitative safety data: The CIRAS project. *Human Relations, 56*(5), 587-607. doi: 10.1177/0018726703056005004. **Note on quality:** This peer reviewed journal has an impact factor 1.93.
5. Wallace, B., Ross, A., Davies, J. B., Wright, L., & White, M. (2002). The creation of a new minor event coding system. *Cognition, Technology and Work, 4*, 1-8. url: http://link.springer.com/article/10.1007/s101110200000. **Note on quality:** This peer reviewed journal focuses on the practical issues of human interaction with technology, in particular, how human cognition affects, and is affected by, work and working conditions.
6. Davies, J. B., Wright, L. B., & Courtney, E. C. (2000). Confidential Incident Reporting on the UK Railways; the CIRAS System. *Cognition, Technology and Work,* 2, 117-125. url: http://link.springer.com/article/10.1007%2FPL00011494?LI=true# **Note on quality:** Same as 5.

Grant funding: Between 1996-2001 Professor Davies tendered for and won a total of 13 grants to study human errors and develop CIRAS. The total value was £1.75 millon and included:

- Davies, J.B. (1996-1998) Scotrail, Railtrack, HSE, British Rail Board: Study of Human Factors Errors, £139,000.
- Davies, J.B. (1997-1999) Great North Eastern Railways: Enrolment of Safety Critical Staff to CIRAS programme, £40,000.
- Davies, J.B. (1998-1999) Railtrack (Scotland Zone), Jarvis, Bovis, Semple-Cochrane, Scott Wilson Railways, Rigblast, Westinghouse Signals, Adtranz: Enrolment of contracting staff to CIRAS programme, £42,000.
- Davies, J. B. (1998-2000). First Engineering: Enrolment of staff in CIRAS programme, £40,000.
- Davies, J.B. (1999-2000) Railtrack: Enrolment of staff in CIRAS programme, £33,222.
- Davies, J.B. & Human Factors Analysts Limited (2000-2001) GT Rail Maintenance: Enrolment of staff in CIRAS programme, £45,000.
- Davies, J.B. & Human Factors Analysts Limited (2000-2001) Railtrack (Safety and Standards Division): Set up and run a mandated national CIRAS system for the UK train operating companies, £1.2 million.

4. Details of the impact (indicative maximum 750 words)

Process: From research to impact. Following initial experimental work arising from the grant funding from Scotrail in 1996, Professor Davies' team developed a prototype CIRAS system which was designed to classify the reports received into technical codes or human action codes based on the narratives from train drivers, conductors, signalling staff, maintenance staff and railway management. Over the next three years, staff operating trains in Scotland (Scotrail, Virgin Trains, GNER, Railtrack Scotland and GT Engineering) were enrolled into the CIRAS programme. Following the Ladbroke Grove rail crash in 1999, the Government took the decision to extend the

CIRAS system to cover train operators in England and Wales. In fact, CIRAS was specifically mentioned in the Cullen Report into this accident. Paragraph 9.61 notes that "A confidential reporting system, CIRAS, is now in place across the industry. This allows employees to report safety-related incidents confidentially. It undoubtedly enables "near miss" incidents to be reported and receive attention. It also enables incidents to be categorised by type and location, and to measure trends. It has great merit. It is to be hoped that in the longer term the culture of the industry would be such as to make confidential reporting unnecessary. I accept that this situation may be a long time in coming to pass in the industry. In the meantime I fully support and encourage the further use of the CIRAS system" (Source G).
CIRAS continued to operate as a Charitable Trust until 2008 when, following extensive consultation, the Railway Safety and Standards Board took over its management and governance. They expanded its remit immediately and significantly. The system was opened up so that everyone working in any capacity on the railway network in England, Scotland and Wales could use it. The coding system was significantly modified and expanded to take into account a much wider variety of safety issues, and changes were made to the screening of reports ensuring that the focus was on detecting and processing only safety critical reports. Additionally, once the CIRAS team had resolved problems through consultation with the relevant companies, any key safety lessons learned were shared with all users of CIRAS publications. A significantly expanded database was introduced during 2011, building on the 16 years of data that the taxonomic system had already accumulated and increasing the ability to diagnose and resolve source problems. The CIRAS website was also rebuilt, making it more user-friendly and accessible to use with mobile devices. This case study concerns the impact of the expanded CIRAS system.

Types of impact: The research on human factors in the railway industry has led to:

- The adoption and use of a confidential reporting system across the UK Railway network
- The construction of a database to classify and resolve safety issues before they occur
- Sharing of best practice on safety within the UK railway industry
- Enhancements to passenger and freight transport safety
- Influence on the development and implementation of a reporting system in the US and Canada

Adoption of CIRAS: Since 2008, the number of companies using CIRAS has grown steadily. There are now over 300 companies registered (Source F), although the number of companies involved fluctuates as maintenance and operation contractors change. The safety service that CIRAS provides is open to train and freight operators, Network rail and its suppliers, London Underground, Heritage Rail and Light Rail.
Database of safety issues: Currently, the CIRAS Report Library (Source B) contains 17 categories of health and safety concerns, including fatigue, infrastructure, security, signalling, stations and platforms, training and workloads. Companies value CIRAS for bringing safety issues to light which could otherwise have been undetected and unresolved.
Sharing best practice and improvements to passenger safety: In addition, companies are able to share safety lessons via CIRAS publications. In 2008-9, more than 300 reports were made to CIRAS, resulting in 32 instances where CIRAS was able to negotiate tangible changes (Source C). For example, a CIRAS report from that year raised a signal passed at danger (SPAD) risk at platform 9, Liverpool Street station. As a result of CIRAS' intervention, a review was undertaken of the signal controls at this junction and subsequently train operating procedures were changed (Source B). The estimated level of SPAD risk in March 2012 was 69% lower than September 2006. The number of potentially severe SPADs occurring fell from 43 in 2003-2004 to nine in 2011-2012 (Source K). In 2009-10, the number of reports to CIRAS grew to 561, with 117 positive actions. Eighty five of these processed reports contained information which was new to the company concerned. One report revealed that train drivers had spotted a loophole in the rules associated with emergency speed restrictions allowing them to drive above the speed limit. The positive action taken by the company was that The Rule Book and Railway Group Standard were changed so as to prevent a derailment through inappropriate speed. The Rail Safety & Standards Board's annual board meeting reported that the implication of this report to CIRAS was that potential accidents had been prevented (Source D). In 2010-11, the number of reports made to CIRAS continued to grow to 679 (Source E), and in 2011-12 the number had risen to 855 with 50% of all reports resulting in

positive action and 30% of reports containing new information to the company concerned (Source F).

The CIRAS system works constantly behind the scenes, making sure that no safety issues are overlooked or unreported, and helps to improve future railway safety performance through gathering data on types of errors, faults and their causes (Source A). The Rail Safety & Standards Board's annual safety and performance report for 2011-12 (Source I) reported that: between 2008 and 2012 there were no passenger or workforce fatalities resulting from train crashes on Great Britain's mainline railway; in 2011-12 the ten-year average for the number of train accidents resulting in passenger or workforce fatalities was less than one every two years for the first time ever; the number of passenger fatalities was the lowest level on record; the total number of public fatalities in 2011-12, excluding trespass and suicide, was eight (lower than in previous years). A Workforce Risk Review published in 2012 (Source J) presented the recurrent themes arising from the Office Rail Regulation (ORR) inspections, Rail Accident Investigation Branch (RAIB) investigations and CIRAS reports. Nine out of the ten recurrent themes were raised by CIRAS reports, whereas ORR inspections highlighted four and RAIB investigations highlighted six of the recurrent themes, respectively.

International influence: Beyond its extensive use in the UK, CIRAS has also impacted on the development of other confidential reporting systems, such as C^3RS, the Confidential Close Call Reporting system launched by the Federal Railroad Administration in the USA (Source L). Primary C^3RS stakeholders include the US Department of Transport, Amtrak, Canadian Pacific Railway and the Association of American Railroads. The Federal Railroad Administration stated that they used lessons learned from CIRAS when developing and implementing their system and that previously unknown safety issues are being discovered, with resulting actions having a positive impact on safety (Source L) "The FRA implementation team benefited from the existing literature on confidential close call reporting systems … (including the) United Kingdom's Confidential Incident Reporting and Analysis System (CIRAS); Davies et al., 2000."

5. Sources to corroborate the impact (indicative maximum of 10 references)

A. A Letter from Maurice Wilsdon, Head of National Programmes, Railway Operations and CIRAS, 21st March 2012.
B. CIRAS Report Library (http://www.ciras.org.uk/report-library/)
C. CIRAS Committee Annual Stewardship Reports 2008/9 http://www.rssb.co.uk/sitecollectiondocuments/publications/board_discussion/CIRAS%20Comm%20Stewardship%20RSSB.pdf
D. CIRAS Committee Annual Stewardship Reports 2009/10 http://www.rssb.co.uk/SiteCollectionDocuments/CIRAS%20Stewardship%20Report.pdf
E. CIRAS Committee Annual Stewardship Reports 2010/11 http://www.rssb.co.uk/Publications/Documents/Agenda%20Item%2007%20CIRAS%20Stewardship%20Report.pdf
F. CIRAS Committee Annual Stewardship Reports 2011/12 http://www.rssb.co.uk/AboutUs/Documents/CIRAS%20Stewardship%20Report.pdf
G. Cullen Report: The Ladbroke Grove Rail Enquiry. Paragraph 9.61. http://www.rail-reg.gov.uk/upload/pdf/incident-ladbrokegrove-lgri1-optim.pdf
H. Britain's Growing Railway: Association of Train Operating Companies http://www.atoc.org/latest-publications
I. Rail Safety & Standards Board Annual Safety Performance Report and Workforce Risk Review 2011/12 http://www.rssb.co.uk/SPR/Documents/ASPR_2011-12_FullReport.pdf
J. http://www.rssb.co.uk/AboutUs/Documents/Workforce%20Risk%202012.pdf
K. SPAD and TPWS activity report, Quarter 3 – 2012-2013 http://www.rssb.co.uk/SPR/REPORTS/Documents/2012-13%20Q3%20SPAD%20TPWS%20Report.pdf
L. Developing an effective corrective action process: Lessons learned from operating a confidential close call reporting system. http://ntl.bts.gov/lib/47000/47100/47128/Lessons_Learned_from_operating_a_confidential_close_call_reporting_system.pdf