“FUTURE DIRECTIONS IN HUMAN FACTORS RESEARCH”

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Note: The following thoughts and opinions are offered in lieu of an official paper for AusRAIL 2005. Due to attendance at some serious incidents in the weeks prior to the event, time constraints prevented the preparation of a referenced paper.

Introduction

Human factors research offers organisations and industries opportunities to improve safety and operational performance. While there is a tremendous amount of research that is conducted by operators, regulators, academic institutions and other organisations, there needs to be a more structured approach to selecting topics that better align with safety and operational needs. In order to optimise the maximum benefit from human factors research in the rail industry, topics should be of an applied nature and should be linked with what is actually happening in industry. Today’s presentation will focus on the benefit of human factors research, methodologies in selecting research topics as well as touching upon some research that is currently being undertaken.

Reasons for Change

Human factors research and application within the rail industry has steadily evolved and gained momentum over the last several years. The reasons for this appear to be due to commercial and organisational changes within the industry, as well as the community or society view of incidents. The contribution of “human error” in relation to rail incidents, coupled with the associated increase in media coverage of incidents, has raised the profile of the field of human factors. The public and the clients that rail organisations rely on for viability are not tolerant of serious incidents. The political interest in the industry also demands safe and efficient operations.

Response to Change

In response to these demands, the rail industry globally has responded to the changes in the industry. In Australia, many rail organisations have now appointed Human Factors Specialists and are not only undertaking research, but are implementing human factors principles and practices throughout operational systems. While to begin with, human factors seemed to have been used on an individual basis, as a discipline it appears to have become ingrained on more of an organisational level. The overarching objective behind integrating human factors within organisations is continuous improvement in health and safety performance and in turn, reducing the risk to passengers, employees and the public.

However, there are still some organisations who are using human factors on an as needed basis rather than integrating it within the system overall. While using human factors studies as a basis to identify the contributing factors behind individual issues, such as Signals Passed at Danger (for instance, by identifying driver sighting and reaction time to signals), it should be noted that human factors implementation and integration within an organisation has a lot more to offer.

What is Human Factors?

Before proceeding, it is timely to revisit exactly what human factors is. Human factors is a wide ranging discipline which refers to the study of humans as components of complex systems made up of
both people and technology (often referred to as sociotechnical systems). Human factors looks at the system as a whole and its influence on how people behave and interact within the Industry. It is important to note that human factors is not only concerned with individuals, but also the collective role of all people within the system.

The field is concerned with optimising human performance in the workplace and not only focuses on the capabilities of people, but perhaps more importantly, their limitations. The aim of human factors is to optimise the relationship between personnel and systems with a view to improving safety, efficiency and well-being.

Human factors, as a discipline, covers many areas, including:

- human physiology;
- psychology (including perception, cognition, memory, social interaction, error);
- work place design;
- environmental conditions;
- human-machine interface;
- anthropometrics (the scientific study of measurements of the human body).

### Human Factors Research

Human factors researchers study system performance. That is, they study the interaction of personnel, the equipment they use, the written and verbal procedures and rules they follow, and the environmental conditions of any system. Human factors is concerned with both the human interactions with the technical components of the system (e.g. operating, monitoring, maintaining) and the wider human activities required to sustain the system (e.g. training, work organisation).

Topics vary and can include:

- From an individual perspective, issues such as attitude, skills and personality.
- When looking at collective roles, issues such as culture, communication and supervision.
- Finally, looking at the job itself, issues such as equipment, procedures and workload.

### What Can Human Factors Research Do?

A Signal Passed at Danger (SPAD) is a relatively common event in the rail industry and there has been a great deal of focus on how to manage and reduce SPADs. Whereas in the past, the focus was on the Driver doing the wrong thing, the present perspective considers the influences that led to the event.

As the Rail Safety and Standards Board in the UK states:

>“Humans are often identified as one of the causes of an incident, but Humans rarely make mistakes on purpose. The Human Factors discipline has a body of knowledge, tools & techniques to identify adverse effects on Human performance, potential errors and solutions to minimise any impact. This can significantly reduce the chance of an incident occurring and any subsequent loss to performance, property or Human life.”
As noted by the Railway Industry Advisory Committee (RIAC), contributing factors in incidents involving Signals Passed at Danger can include:

- A lack of infrastructure maintenance
- Poor signal sighting design
- Poor train cab design and layout
- Operational management decisions, for example design of rosters and duty diagrams
- Insufficient or ineffective training design and competence management
- Low track adhesion

The following project proposal highlights the relevance of researching SPADs with a human factors focus.

“A high proportion of SPADs are attributable to human causal factors. This is not surprising as the task of train driving and operation of the railway relies heavily on humans interacting with the equipment and each other. Safety systems and driver vigilance devices such as Automatic Train Protection (ATP), Automatic Warning System (AWS), Train Protection and Warning System (TPWS) and Driver’s Reminder Appliance (DRA) have been introduced to help prevent SPADs, or mitigate against the effects of a SPAD. However, the driving task is still essentially a human one. It is difficult for any human to complete the driving task, day in day out, without ever making an error.

Some examples of the many underlying human factors influences on the likelihood of a SPAD occurring are described below:

- Although the driver sees the red signal and correctly identifies that it applies to them, they then make the assumption that the signal will change to a less restrictive aspect before they get to it. Assumptions like these are made as a result of the driver's past experience of driving on that line.

- When starting away from a location (typically a station), the driver forgets to check the signal before moving off, immediately resulting in a SPAD. This may occur due to a number of contributing factors:
  - The driver forgets to check the signal
  - The driver is given conflicting information from other staff
  - The driver is distracted by events happening in the driving cab or outside the train such as a passenger slip at the platform/train interface
  - Environmental conditions such as poor lighting or adverse weather.

- When a number of signals are displayed in one location the driver may select a signal that is inappropriate for their track. Contributory factors to this type of SPAD include the signal's position in relation to the line the driver is travelling on and the drivers' route knowledge.

- The drivers' task has become more monotonous over recent years, partly as a result of limited routes and little variation in the type of rolling stock being used. Other factors include the improvement in driving conditions (more comfortable cabs) and standardisation of cab
equipment. The driver's attention may therefore wander away from the task and be diverted for long enough (eg. when a fault occurs on the train) to miss a signal when it is within their potential visual field.

- Poor communication between the driver and signaller can also cause SPADs, particularly in engineering sites ('possessions'), in railway yards and sidings. The failure of the driver and signaller to come to a clear and complete understanding, then results in the driver believing that it is safe to proceed through a red light.
- Environmental conditions including background noise, the thermal conditions inside the cab and the weather. Lighting conditions (fog, sun, rain, snow for example) can distort brightness, contrast and the driver's perception of distance.
- Stress and tiredness can reduce the driver's ability to concentrate. Stress may be caused by events at work or at home, such as a death in the family, coupled with lifestyle factors (sleep patterns, diet, general health).

So instead of focusing on who did something that led to an incident such as a SPAD, the current way of thinking considers human factors and looks at why such an incident may have occurred. This human-centred approach is also used when considering corrective actions or strategies to address issues. The National SPAD Focus Group (NSFG) in the UK has recommended a number of human-centred approaches to minimising the occurrence of SPADs, grouped under the following headings:

**Safety critical communication**

With any safety-critical information, it is vital that the message being relayed is clearly understood. This is particularly important for communication between drivers and other railway staff (mainly signALLers and handsignALLers) to avoid SPADS - and also for protection of the line when a SPAD has occurred. Practice in this area now includes:

- Keeping the message clear by avoiding the use of jargon, keeping the message short and simple
- Always ensuring that the message is fully understood by the other parties by asking them to repeat back what has been said
- Use of the phonetic alphabet when describing signal numbers, locations etc.
- Always confirming who the other party involved in the communication is and ensuring that it this is the right person with the right level of authority
- Only using authorised communication systems - signal post telephones or cab-signalbox radio for example
- Encouraging individuals to always ask for clarification if there is any doubt, to remain calm and to make notes if this would assist with remembering important details later.

**Professional train driving**

The concept of ‘professional driving’ is a holistic approach to ensuring that the driver is fully aware of, and manages, all those factors that affect their performance. The approach focuses on establishing
clear policies and instructions, providing the driver with the skills to handle the train effectively, the knowledge to make effective decisions and judgments (including SPAD training, lifestyle training, route and traction knowledge and an understanding of the roles of others in the operation of the railway) and finally by providing opportunities for this knowledge to be regularly updated and practised.

- **Defensive driving**
  A defensive driving approach focuses on enabling the driver to anticipate and respond to scenarios in a way that minimises the inherent risk of a SPAD. Defensive driving ensures that safety has priority over punctuality and there are many factors that can promote a defensive driving technique, including the driver’s braking technique and the strict adherence to speed restrictions.

- **Lifestyle**
  Research has shown that lifestyle factors have can have a significant effect on the performance of drivers. The industry has developed policies, training packages and support for drivers and signallers in this area, including:
  - Understanding the impact of shift work
  - Adequate rest between shifts
  - Drug/alcohol abuse

- **Driving cab discipline**
  Cab discipline focuses on the working environment of the driver, including potential distractions. There are many factors that challenge a driver’s cab discipline and again, the industry has been working to make improvements in this area including:
  - Not permitting unauthorised people and/or articles in the cab
  - Ensuring that unnecessary tasks and/or communication does not take place whilst driving
  - Having key documents in a convenient location

- **Route and traction knowledge**
  Route knowledge is central to ensuring that drivers are fully aware of, and understand the implications of the general characteristics of the routes over which they will drive, the specific SPAD risks and any other significant risks that may be encountered. A number of aids are available for drivers to gain knowledge about the traction type and of the routes over which they will be operating:
  - Hands on experience of the traction type
  - Full motion driving simulators
  - Desktop computer-based simulation or information packages
  - Company route maps

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<th>The Impact of Human Factors</th>
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- In 2002, nineteen employees sustained fatal injuries within the US Railroad Industry. An analysis of these incidents which was released this year found that the predominant contributing factor involved in most of the incidents was human factors.
• Two Safety Board investigations of passenger train accidents in early 1996 in the United States at Secaucus, New Jersey, and Silver Spring, Maryland, have led to significant recommendations on the physical testing for qualification of train crews and signal system design.
  
  o Two New Jersey Transit commuter trains collided head-on killing the engineers on both trains and one passenger. The Safety Board determined that the probable cause of the accident was one of the train engineer’s failure to correctly perceive a red signal because of an eye disease and colour vision deficiency which he failed to report to New Jersey transit during annual medical exams.
  
  o In the Silver Spring accident, three crew members and eight passengers on a Maryland commuter train were killed when it ignored a signal and collided with an Amtrak passenger train. The Safety Board said the engineer and crew failed to obey signals because of multiple distractions, and federal and state regulators’ failures to conduct analyses on the human factors impact of signal modifications on that rail line.

• Closer to home, high profile incidents such as Waterfall have highlighted human factors issues with the review and validation of human factors in design and change management.

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<th>Who is Conducting Human Factors Research?</th>
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There are a number of organisations who have structured human factors research programs pertaining to the rail industry, as well as other organisations who have useful resources / papers. Just some of the organisations (primarily from the UK and USA) are listed below. Further details on these organisations are contained within Appendix A of this paper.

• Rail Safety & Standards Board - UK
• Transportation Research Board – USA
• Federal Railroad Administration – USA
• Health and Safety Commission’s Railway Industry Advisory Committee (RIAC)
• Department of Transportation Human Factors Coordinating Committee - USA
• The Yellow Book – UK
• Rail Research - UK
• Volpe National Transportation Systems Center – Operator Performance and Safety Analysis Division (OPSAD) - USA
• Transport Canada - Transport Development Centre
• National Transportation Safety Board - USA
• SPAD Web – UK
• European Rail Research Network of Excellence (EURNEX)
United Kingdom

The Rail Safety & Standards Board (RSSB) in the United Kingdom is conducting some state of the art research in relation to rail human factors. They have completed many human factors research projects on a range of topics. Current human factors research projects include the following:

- Design of train cabs (including a Cab design code of practice)
- CCTV cameras at platforms for driver use
- In cab CCTV monitors for driver only operations
- Train driver selection and psychometric testing
- Train driver route knowledge
- European Rail Traffic Management System (ERTMS)
- The impact of sleep apnoea and fatigue on drivers
- Train driver visual strategies
- Design of control rooms
- Designing for people with disabilities
- Anti-trespass signs

A more comprehensive list and explanation of the research projects can be seen at Appendix B.

United States

The Federal Railroad Administration in the States has a Strategic Plan for Railroad Research and Development. Ten program elements were developed based on historical risk and incident analysis, strategic review of industry trends, and a review of current research, development, and demonstration projects promising significant results. One of the ten program elements is Human Factors.

It is worth noting that of the total number of reported railroad incidents in the United States in 2000, 38 percent were ascribed to human factors causes, 36 percent to track defects, 12 percent to equipment failures, 2 percent to signals, and 12 percent to miscellaneous causes.

The human factors program element addresses railroad incidents in two primary areas: Operating Practices and Grade Crossings. Operating Practices Projects target human factors accidents in yards and terminals and in mainline train operations. Human factors-related grade crossing projects address issues regarding motor vehicle drivers, visual and audio warnings, and crossing gate and light technology to reduce incidents.

The human factors program element also provides analytical and technical support to reduce the number of incidents, deaths, and injuries due to human error, and to reduce the rate of railroad employee-on-duty fatalities, injuries and illnesses. The program element uses a “human centered systems” approach, that focuses on human capabilities and limitations with respect to human/system interfaces, operations and system integration. The Federal Railroad Administration hopes that
increased attention to human performance and behavior will reduce incidents, loss of life, injuries, property damage and resultant personal and financial costs.

**What’s Happening in Australia?**

Rail CRC is the Cooperative Research Centre for Railway Engineering and Technologies and Australia's premier rail research centre. Rail CRC started operation on 1 July 2001 and is part of the Commonwealth Government CRC program, which brings together industry and research providers to advance Australia's research and development efforts.

In 2000 it was found in Australia, that only 10 of 178 (or 5.6%) of railway industry companies implement their own research, which is mostly concentrated on short-term projects, involving problem solving and incident investigation. The benefit of the Rail CRC is that the Australian railway industry has a national focus for research and consultancy services. The current funding will expire in 2007-08. In order for the Industry to continue to receive CRC funding from the Commonwealth Government, a new application is planned to be lodged in early 2006.

The Australasian Railways Association (ARA) convened a meeting in Melbourne on 8th September 2005 for key representatives to get together and develop a research and development strategy to assist the ARA Executive Committee in its decision making.

The Research and Development Strategy Workshop Program included:

- Mapping of the environment in which the rail industry operates (a scan of the current environment within which the industry operates)
- Agreeing on an Industry vision (outline what the future rail industry will look like as a basis for identifying priority areas for research and development)
- Outlining Research and Development Objectives (used to develop projects against with relevant targets)

The three part Research and Development Program consists of:

- Economic and social research – striving to improve the rail industry’s contribution to Australia
- Safety and Human Factors – seeking to ensure rail maintains its safe reputation
- Engineering – working to design engineering solutions to improving productivity.

**Identifying Research Needs**

An important force driving the implementation of human factors research programs from an organisational view is the increasing commercial costs of incidents and their effect on company profits and financial viability, as well as the social and environmental impact of occurrences.

So how should research, particularly human factors research, be identified as a need within the rail industry? As mentioned earlier, the key to any research should be the link to the operational and safety requirements of organisations and the industry. Rail human factors research should be useful to the industry – of an applied nature.
There needs to be a structured approach to selecting human factors research needs and the following steps are part of a relatively objective assessment process which is used by the Federal Railroad Administration:

**Step 1. Review of historical and potential risk in the railroad industry**

The first step in selecting research and development needs should be a review of rail industry incidents where there was actual or potential serious injury or damage to equipment. While the actual consequence events will be rare, the incidents with potential consequences will no doubt yield many incidents with a high frequency rate, but minimal actual consequence – the so called ‘near misses’. These types of incidents are the most valuable source of data for analysis as they indicate where the system is vulnerable, without having to suffer a loss. The near misses should be used as a free lesson to investigate and address any deficiencies prior to a serious incident.

The contributing factors for these incidents should be identified, providing a deeper understanding of the characteristics of high-consequence events. This will enable organisations to come up with a list of potential risks to industry and an understanding of future safety hazards.

**Step 2. Countermeasures**

The next step is to consider the factors that are part of the incident sequences and identify specific items that need to be addressed to reduce the risk or mitigate the consequences of potential hazardous incidents identified in Step 1. Similar to fault-tree logic, the specific items represent points along the incident sequence where the incident or consequence could have been prevented. Countermeasures are proposed with the aim of preventing, trapping or mitigating the incident sequence. Typical countermeasures could include:

- New or revised regulations.
- Industry standards and best practices.
- Equipment and infrastructure improvements.
- Enforcement.
- Education

**Step 3. Survey industry countermeasures and research and development requirements.**

Once countermeasures are compiled, those that could be enabled or implemented via research and development can be identified. For example, a potential operating rule may need research into the train speed regimes at which a particular type of train control system affords safe operation.

**Step 4. Develop and rate individual projects.**

For each countermeasure that may be aided by research and development, one or more project summaries are developed to describe projects that provide information to enable the countermeasures. The project summaries are structured descriptions of projects that would be used to compare and select projects during research and development program development. Project summaries address expected outputs and outcomes, project costs and durations, as well as implementation issues for project results.

Based on the project summaries, projects are then rated according to objective criteria for expected contribution to safety and likelihood of success. For a given program area, these project ratings are plotted in two dimensions (likelihood of success versus contribution to safety) to provide a high-level comparison tool for the project selection process.
Step 5. Select projects and assign to program areas.

The last step in the research program development process entails selecting projects for each program area based on the two-dimensional plots and project summaries. The goal is to select the best research opportunities available to obtain the best return on investment possible from the budget available. That is, the most highly rated projects, regardless of program area, are selected to develop budget request estimates. Once the budget has been finalised, the projects are revisited, and funding levels and schedules are adjusted appropriately. The research and development budget request, for each program area, becomes the sum of the funding required for each of the selected projects in the program area.

Adopting a structured methodology such as that described above, ensures that the focus is on safety and operational improvements, that projects are relevant and of an applied nature and that there will be a return-on-investment.

Future Direction

So what will future human factors research bring? Rapid changes in technology and in the structure and nature of the rail industry dictate to a large extent the type of research that occurs (and of course, the availability of funding). The industry seems to have dealt with ‘traditional’ issues such as fatigue, rosters, engineering issues and medical fit-for-work.

The future direction for human factors research really lies with the changes in technology and the workforce. With any changes in technology, there needs to be consideration of the associated implications of the changes on workload, stress and fatigue caused by work schedules. Computerised aids and automation are the way of the future and will have radical changes on the way people interact with the equipment, each other and the overall system.

Other research is being conducted as a result of success shown in other industries. For example, Crew Resource Management (CRM) – which is one example of the application of human factors knowledge – has shown consistent results in reducing human error within the aviation and marine industries. Overseas countries are researching how best to apply CRM within the rail industry.

Within Australia there is currently a major project organised by the Department of Infrastructure (DOI) and Independent Transport Safety and Reliability Regulator (ITSRR) to introduce a Rail Resource Management program within industry. As stated by DOI and ITSRR, the benefits of integrating CRM training include improving crews’ skills to identify threats to an operation and mitigate against human error by the utilisation of all available resources – human, informational, procedural and equipment – in order to achieve a safe and efficient outcome. CRM skills typically refer to specific competencies such as team communication and co-ordination, planning and contingency management, critical decision making, situational awareness, workload management, leadership and assertiveness.

Learning from Other Countries / Industries

While some other Countries, industries or organisations may be considered leaders in the field when it comes to human factors research and application, this only bodes well for others who may be a few steps behind. There has been an incredible amount of research done over the past few decades in relation to human factors and lessons can be learnt and shared across countries, industries and organisations. While a specific piece of research may be applicable to one domain or transport mode, there may well be some background research or references which can migrate across to the rail industry. The lesson in this? Ensure the initial literature review prior to commencing research is thorough, looks at global efforts and is not restricted to the rail industry. Examine and review human
factors research literature and projects from other industries such as mining, aviation and medical industries.

**Conclusion**

Human factors research should be effective, practical and add value to safety and operational performance. By using a structured process for identifying issues that warrant research and development, the emphasis will hopefully remain on safety and operational requirements and can only bode well for the success and well being of the industry.
RAIL HUMAN FACTORS RESEARCH - ORGANISATIONS

There are a number of organisations who have structured human factors research programs pertaining to the rail industry. Just some of the organisations (primarily from the UK and USA) include:

* Rail Safety & Standards Board - UK

The company's prime objective is to lead and facilitate the railway industry’s work to achieve continuous improvement in the health and safety performance of the railways in Great Britain, and thus to facilitate the reduction of risk to passengers, employees and the affected public. The site provides details of the company’s activities as well as copies of Human Factors research reports.

Internet Link: http://www.rssb.co.uk/

* Transportation Research Board – USA

A division of the National Research Council, the Board serves as an independent adviser to the federal US government and others on scientific and technical questions of national importance. Its mission is to promote innovation and progress in transportation through research.

Internet Link: http://trb.org/

* Federal Railroad Administration - USA

The Federal Railroad Administration (FRA) promulgates and enforces rail safety regulations; administers railroad assistance programs; conducts research and development in support of improved railroad safety and national rail transportation policy; provides for the rehabilitation of Northeast Corridor rail passenger service and consolidates government support of rail transportation activities. The FRA funds a significant amount of human factors research and this site allows users to download many of the reports.

Internet Link: http://www.fra.dot.gov/us/content/2

* Health and Safety Commission’s Railway Industry Advisory Committee (RIAC)

RIAC plays an important role in providing a strategic forum for railway industry stakeholders. It provides advice to the HSC on railway safety, exchanges information, comments on proposed new regulations and guidance and works to progress health and safety issues and other related developments within the industry.

* Department of Transportation Human Factors Coordinating Committee - USA

The Coordinating Committee's goals are to effect the development and implementation of a national strategic agenda for inter-modal human factors research and application in transportation and to be a significant human factors information resource to the transportation community. Much of their work to date has focused in the area of fatigue.

Internet Link: http://scitech.dot.gov/research/human/index.html
* The Yellow Book - UK

The Yellow Book web site describes engineering safety management for the UK's railways and has an electronic version of the Yellow Book. The yellow book also has a series of application notes, each providing more detailed, practical guidance on a particular topic one of which is entitled ‘Human error: causes, consequences and mitigations’.

*Internet Link: http://www.yellowbook-rail.org.uk/

* Rail Research - UK

Rail Research UK is funded by the EPSRC and provides an opportunity for academic researchers and industry bodies who are committed to working together more closely, to increase scientific knowledge in rail systems through co-ordinated research. The Human Factors research sits within the whole systems performance theme.

*Internet Link: http://civ-hrg.bham.ac.uk/RailResearchUK/performance.htm

* Volpe National Transportation Systems Center – Operator Performance and Safety Analysis Division (OPSAD) - USA

The Operator Performance and Safety Analysis Division (OPSAD) resolves problems across all transportation modes by performing research to analyse the relationship between human behaviour and transportation safety and productivity. Research reports relating to rail Human Factors issues can be downloaded.

*Internet Link: http://www.volpe.dot.gov/opsad/

* Transport Canada - Transport Development Centre

This link provides access to Transport Canada’s R&D programme which focuses on the human factors affecting operator performance and on the ergonomic design of systems and equipment. Covering all transportation modes, the research is designed to optimise the safety, productivity, and capacity of human-machine systems.

*Internet Link: http://www.tc.gc.ca/TDC/projects/hfactors/menu.htm

* National Transportation Safety Board - USA

The National Transportation Safety Board is an independent Federal agency charged by Congress with investigating every civil aviation accident in the United States and significant accidents in the other modes of transportation -- railroad, highway, marine and pipeline -- and issuing safety recommendations aimed at preventing future accidents.

*Internet Link: http://www.ntsb.gov/

* SPAD Web - UK

The website of the rail industry's National SPAD Focus Group - the industry body leading the drive to reduce the incidence of signals passed at danger (SPADs) on the UK rail network.

*Internet Link: http://www.spadweb.com/index.htm
* European Rail Research Network of Excellence (EURNEX)

EURNEX is the European Rail Research Network of Excellence and aims to integrate a fragmented research landscape, promote the railways contribution to sustainable development and improve the competitiveness and economic stability of the European rail sector. The EURNEX Council met on the 11th February as work got under way to make the Network a functioning node for rail research. The meeting was organised by the University of Birmingham and brought together diverse members of the EURNEX network, including the supply industry, the railway operators and the Universities and Institutes representing European rail research according to region.

Since the starting date of EURNEX, January 1st 2004, the Council have made progress on the setting up of the Advisory Board and the Scientific Board. Further, many of the working groups have begun their work and some deliverables will soon be achieved.

*Internet Link: http://www.eurnex.net/*
### RAIL SAFETY & STANDARDS BOARD (RSSB) –  
### CURRENT HUMAN FACTORS RESEARCH / PROJECTS

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<tr>
<th>Project title and number</th>
<th>Description of Project</th>
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<tbody>
<tr>
<td><strong>Operations</strong></td>
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<tr>
<td>T59 Human factors study of fatigue and shiftwork</td>
<td>Investigating the effects of fatigue on train drivers and optimising shift work practices to reduce risks arising from fatigue and to improve performance.</td>
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<tr>
<td>T321 Research into safety and other signage at stations</td>
<td>Assessing the benefits, costs and issues associated with standardising station signage. Determining a standard for non-safety signage and the need for a signage hierarchy. Considering signage placement and lighting.</td>
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<tr>
<td>T322 An investigation into trespass and access via the platform ends at railway stations</td>
<td>Investigating causal factors of trespass via station platform ends, and legitimate access requirements of authorised persons. Developing options for measures to mitigate the former without impeding the latter.</td>
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<tr>
<td>T158b Station tactile surfaces - Phase 2</td>
<td>Investigating the use and location of tactile surfaces at stations. Reviewing potential new materials. Assessing benefits and risk of extending their use to stair and escalator tops and as guideways for people with disabilities.</td>
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<tr>
<td>T332 Understanding the risk at station and barrow crossings</td>
<td>Examining the requirements for the use of station and barrow crossings to traverse the track. Assessing current safety controls, and the scope of procedural or technical innovation to reduce risk.</td>
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<tr>
<td>T150 Driver route knowledge</td>
<td>Understanding how route knowledge features in the driver’s tasks and how it can be best supported to avoid incidents related to route knowledge shortfalls.</td>
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<td>T152 Driver visual strategies</td>
<td>Providing guidance to improve the visibility of trackside information by investigating driver visual strategies.</td>
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<tr>
<td>T317 Minimising the impact of suicides on staff</td>
<td>Identifying ways to prepare railway staff for the possibility that they may witness suicides Determining the most appropriate support systems to reduce post-incident trauma.</td>
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<td>T333 Evaluating best practice deterrence and enforcement mechanisms at level crossings</td>
<td>Understanding best practice in the application of red light cameras, car number recognition, CCTV and other systems and fixed penalty regimes, as deterrent and enforcement mechanisms at level crossings.</td>
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<tr>
<td>T334 Reducing the risk to motorists traversing user worked crossings on foot</td>
<td>Examining technical solutions, to risk reduction at user worked crossings. Users are currently required to traverse the crossing four times on foot to open and close gates.</td>
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<tr>
<td>T337 Rail industry human factors good practice guide</td>
<td>Developing a guide to human factors good practice, containing case studies demonstrating the use of human factors principles.</td>
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<tr>
<td>T340 Research into psychometric testing</td>
<td>Reviewing and evaluating standards and procedures for the use of psychometric testing in recruitment for safety critical roles, and in post-incident testing, particularly for drivers.</td>
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<td>Project Code</td>
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<td>T341</td>
<td>Reducing accidents and collision damage in maintenance depots  Analysing the precursors of accidents and collisions within maintenance depots, with particular reference to depot design and layout. Evaluating mitigation measures.</td>
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<td>T343</td>
<td>Reducing SPADS – good practice and solutions for driver management  Defining best practice in driver management in Britain and international rail companies. Identifying strengths and weaknesses in driver management in Britain. Recommending improvements and producing a 'good practice guide'.</td>
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<tr>
<td>T365</td>
<td>Collecting and analysing railway safety critical communication error data  Understanding the importance, cost and types of safety-critical communications failures involving front-line railway staff by capturing and analysing risk and error data from voice recordings and incident reports.</td>
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<td>T368</td>
<td>Reducing SPADs - the role of rail staff other than drivers  Determining which rail staff, other than drivers, have a role to play in reducing SPADs and identifying ways to help them.</td>
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<td>T435</td>
<td>Developing signal sighting strategies for managing conflicting requirements  Helping signal sighting practitioners resolve conflicting requirements and achieve optimal signal sighting.</td>
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<tr>
<td>T443</td>
<td>Improving teamwork on the railway – stakeholder training  Training industry stakeholders to use the toolset generated by the successfully completed project ‘T146 – Improving teamwork in the railway’. Demonstrating the ease of use and effectiveness of the tools.</td>
</tr>
<tr>
<td>T506</td>
<td>Safety critical rule compliance toolkit  Validating the Safety Critical Rule Compliance toolkit (developed in project T145 - safety critical rule compliance) which the industry can use to improve compliance with rules and procedures. Undertaking pilot trials with the industry and further development of the toolkit.</td>
</tr>
<tr>
<td>T508</td>
<td>SPADS involving empty coaching stock and light locomotives  Investigating the causes of an increase in SPADs relating to Empty Coaching Stock trains and Light Locomotives. Proposing mitigations to counter the emerging trend.</td>
</tr>
<tr>
<td>T534</td>
<td>Handsignalling operations, communications and job-aids  Investigating how handsignalling is used at present and the extent to which it could be replaced by other operating methods. Examining how handsignalling risk could be reduced, the Communications Protocol and the use of scripted communications.</td>
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<tr>
<td>T535</td>
<td>The impact of increased numbers of CCTV images on DOO of trains  Assessing the impact on the safe and effective completion of passenger monitoring and door-closing of the driver being presented with increased numbers of CCTV views while operating in DOO mode.</td>
</tr>
<tr>
<td>T541</td>
<td>Human Factors CD ROM Version 5  Disseminating current knowledge about human factors in the railway industry, by publishing a catalogue in the form of a CD ROM. Creating the fifth version of the CD ROM.</td>
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<tr>
<td>T299</td>
<td>Human Factors study of obstructive sleep apnoea in train drivers  Developing a screening tool to investigate the presence of obstructive sleep apnoea (OSA) in a sample of train drivers.</td>
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<tr>
<td>T503</td>
<td>Assessment of Train Drivers dynamic visual acuity  Investigating the effects of age on train drivers dynamic visual acuity.</td>
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<td>Management</td>
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<tr>
<td>**T433 Development and evaluation of TPWS improvements to mitigate reset</td>
<td>Developing a prototype to test improved TPWS functionality that</td>
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<td>and continue risk**</td>
<td>addresses ‘reset and continue’ risk, and evaluating the cost of</td>
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<td>implementing this new functionality.</td>
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<tr>
<td>Safety culture measurement</td>
<td>Development of a safety culture measurement toolkit. This will</td>
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<td>include an approach to measurement and identification of</td>
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<td>interventions to improve a culture.</td>
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<th>Engineering</th>
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<tr>
<td><strong>T326 Human factors good practice guide to managing alarms and alerts</strong></td>
<td>This project will provide railway specific guidelines for</td>
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<td>designing and managing alarms and alerts to improve driver</td>
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<td>performance and reduce risk.</td>
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<td>**T121 Communication for effective passenger behaviour immediately</td>
<td>This research conducts a holistic review of how staff should</td>
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<td>following an incident**</td>
<td>communicate with passengers following an accident/incident to</td>
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<td>promote survivability and reduce injury. Requirements for</td>
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<td>training and equipment will be established from this.</td>
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<td><strong>T399 Review of rail vehicle maintenance and inspection human factors</strong></td>
<td>The project is intended to cover the following key questions</td>
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<tr>
<td></td>
<td>raised in the HF research selection workshop relating to train</td>
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<td>maintenance: Consistency and quality assurance, Signing-off &amp;</td>
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<td>supervision, Planned versus reactive maintenance, Inspection</td>
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<td>tasks and errors, Use of automation, Whole life cost issues (the</td>
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<td></td>
<td>cost of maintaining/improving safety levels), Human factors</td>
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<td>friendly equipment/system design i.e. design for low risk</td>
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<td>maintainability, Managing human error in maintenance operations,</td>
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<td>Paper versus I.T.</td>
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<td><strong>T314 Requirements for emergency lighting on passenger rail vehicles</strong></td>
<td>This project seeks to define better requirements for lighting in</td>
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<td>emergency situations. It will include a literature search to</td>
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<td>identify established best practice elsewhere, followed by</td>
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<td>workshops attended by experts from the rail sector and other</td>
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<td>industries to identify emergency scenarios and lighting</td>
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<td>requirements. The work will inform existing UK standards and</td>
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<td>contribute to emerging European standards.</td>
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<td><strong>T424 Requirements for train windows on passenger rail vehicles</strong></td>
<td>This work will investigate from first principles what safety</td>
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<td>functions are required from windows and how this will influence</td>
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<td>contemporary train design. It will investigate the application</td>
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<td>of new technology and produce a window specification linked with</td>
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<td>the evacuation strategy being established in current research.</td>
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<td>**T442 Completing passenger train safety signage to improve legibility</td>
<td>This small project will design the pictograms required to</td>
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<td>and comprehension**</td>
<td>complete the remaining safety symbols for the fleet following</td>
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<td>on from an earlier project.</td>
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<td><strong>T530 Investigation into the effects of glaring train headlamps</strong></td>
<td>This project will review historical and current developments in</td>
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<td>train headlamp optical requirements, and investigate day-time</td>
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<td>and night-time threshold brightness / visibility capabilities and</td>
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<td>glare limits. Consideration will be given to the existing</td>
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<td>requirements of Railway Group Standards and emerging Technical</td>
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<td>Specifications for Interoperability. A series of workshop</td>
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<td>sessions will be held to determine the acceptability of existing</td>
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<td>train headlamps to drivers and trackside staff. The findings of</td>
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<td>these activities will be used to develop a specification for</td>
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<td>laboratory and field tests, which may subsequently be used to</td>
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<td>determine optimum head lamp characteristics.</td>
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<tr>
<td>T274</td>
<td>Effective human-centred junction signalling</td>
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<td>T347</td>
<td>Failure management of the rail traffic control system</td>
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<tr>
<td>T350</td>
<td>Investigating the design of a display to repeat signal aspects</td>
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<tr>
<td>T345</td>
<td>Review and development of safe working practices in electrified areas</td>
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FEDERAL RAILROAD ADMINISTRATION - PROJECTS

Yard & Terminal Safety

One-Person Remote Operations
Devices to remotely control locomotives in industrial settings, such as steel plants, have been in use for nearly twenty years. Until recently, the use of these devices was not a concern to the FRA since these industrial operations do not fall under FRA jurisdiction. However, in the early 1990's several railroads began to use this technology in yard operations that are within FRA jurisdiction. This technology has the potential to increase productivity and reduce labor costs by enabling a one-person crew to perform all of the functions that were previously performed by a two-person crew. However, there are concerns that this increase in productivity will also degrade safety due to increased workload and fatigue, and other human factors issues. This project will assess the change in accident/injury risk associated with remote operations relative to normal yard operations. The project has been expanded to include a root cause analysis of selected remote operations incidents.

Ergonomic Issues and Root-cause Analysis in Yard & Terminal Injuries
Analyses of railroad supplementary injury and illness records in the Yard and Terminal Injury Evaluation project (completed in FY 2000) indicated that 25 percent of all injuries were due to trip/slip hazards, 23 percent were due to muscle strains, and 11 percent were due to lifting injuries. The Yard and Terminal Injury Evaluation project addressed the immediate causes of these injuries due to employee complacency and/or inadequate training, supervision, and safeguards. A follow-up, root-cause analysis of these injuries will now be performed to identify the chain-of-events that led to the immediate cause of the injury. Individual, environmental and managerial factors will be examined to formulate countermeasures to prevent the recurrence of similar injuries in the future. Some of these injuries may be due to poor ergonomic design and are preventable. This project will identify injuries with ergonomic causes and suggest means to remediate those causes. Among the topics to be addressed are switch stands, hand brakes, and belt packs used for the remote control of switching locomotives. This project (as did its predecessor, Yard and Terminal Injury Evaluation) also provides support to the Switching Operations Fatalities Analysis (SOFA) Working Group which has been examining the contributing factors to fatalities and serious injuries in switching operation.

Maintenance-of-Way Safety
Annually, approximately 10 percent of all on-duty casualties of railroad employees occur during maintenance-of-way operations. As is the case for yard and terminal casualties, anecdotal evidence indicates that there are four primary reasons for many of the incidents leading to these injuries:

- Employee complacency leading to inattention to safety considerations while performing familiar tasks,
- Inadequate training,
- Inadequate supervision, and
- Inadequate safeguards built into procedures and equipment.

The safety implications of fatigue will be a particular focus of this project. Sleep diaries have been distributed to maintenance of way employees and will allow an analysis of work / sleep patterns and fatigue. This project will identify improvements to reduce employee injuries and enhance safety.

Railroad Safety Culture: Behavior-Based Safety Process and Safety Rules Consolidation
Two projects are using the Behavior-Based Safety (BBS) Process, which applies behavioral analysis methods to attain continuous improvements in safety in industrial settings, to improve safety and change railroad safety culture. The BBS methodology identifies and observes safety-critical behaviors to provide positive peer-to-peer feedback for long-term, continuous improvements in safety. This approach has significantly reduced injury rates in many other industries. The success of this approach is not only driven by the systematic reduction of at-risk safety behaviors through peer-to-peer observation and feedback, but also by the systematic identification and mitigation of those organisational barriers (work environment factors, policies, procedures, etc.) which may stand in the way of reducing at-risk behaviors. Positive communication processes help establish commitment in the process at all levels of the organisation, from senior managers to front line employees, often resulting in long-term changes in the “safety culture” of the organisation.

The Consolidation of Safety Rules project is another approach to improving railroad safety culture. Hundreds of
safety rules written in the early 1900’s are outmoded and do not function well with the existing needs of modern railroading. On some railroads, outmoded safety rules have been identified as an organisational barrier to improving railroad safety. It is widely believed that these outmoded safety rules, in conjunction with a punitive disciplinary process, result in a “blame cycle” between management, labor unions, and employees and often discourage the identification and elimination of unsafe behaviors in the workplace. The overall goals of this project are to:

- Consolidate outdated safety rules into critical safety rules and guidelines for safety,
- Write general safety rules and guidelines focused on safety-related behaviors rather than situation-and-site specific rules,
- Include input from labor unions and line staff in the development of a new user-friendly safety rule book,
- Utilise this Safety Rules Consolidation Project as a means of effecting positive change in safety culture.

The BBS process will be used to attain these goals, and the recently established Safety Assurance and Compliance Process in FRA’s Office of Safety, a non-punitive partnership approach between the federal government, railroad management and railroad labor, will assist in implementation.

**Train Operations**

**Fatigue Tools**

This project will develop tools to help detect, manage, and mitigate fatigue in railroad operations. The tools will be developed from fatigue models developed for the U.S. Air Force by Science Applications International Corporation (SAIC), and for the Australian Railroads by the University of South Australia. A minimum of two products will be developed: software and a protocol for determining the role of fatigue in accidents; and software for determining the fatigue produced by a schedule of work. Other tools may include software to analyse the fatigue-mitigating effects of napping strategies, and software to predict future individual alertness levels given a particular work/rest schedule.

**Human Reliability Analysis in Positive Train Control**

The reliability of complex systems is now a routinely analysed aspect of systems engineering. However, while reliability analyses have been routinely performed on electrical, mechanical and chemical systems for many years, it has only recently been recognised that to minimise the probability of system failure, human reliability must also be considered. This project will, in consultation with the Office of Safety and the Railroad Safety Advisory Committee (RSAC) on Positive Train Control (PTC), determine the critical human failure modes in emerging PTC technologies and quantify the human failure probabilities. This project is currently examining the Communications Based Train Management system of CSX.

**Engineman Vigilance Monitoring**

This project will explore recently developed technology to continuously monitor locomotive engineer alertness in real time. It is well known that people are not capable of accurately assessing their own level of fatigue and alertness. Devices that can monitor a person’s alertness in real time can be used to inform that person that they are at risk for falling asleep in the near future, thereby avoiding the use of faulty personal judgement. The first phase of the project identified those technologies that appear to have promise for use in the locomotive cab environment. The devices should have demonstrated capacity to detect declines in alertness, be unobtrusive, and have user acceptance. The second phase tested several devices in two locomotive simulators.

**Dispatcher Readback/Hearback Training**

Human error, including incorrect or inadequate communication, is a causal factor in many accidents. The job of a railroad dispatcher requires extensive verbal communication with train crews and other track users. “Readback/Hearback” refers to the process that a dispatcher and a track user employ in communicating instructions regarding authority for a train, inspection vehicle or track crew to occupy a specific segment of track. This process is intended to prevent miscommunication but its success depends upon the skill of the dispatcher. Air traffic controllers, who perform functions similar to that of railroad dispatchers, use similar procedures. The FAA Academy developed a training module: “ATC Communications,” to improve readback/hearback skills in air traffic controllers. These course materials will be analysed and converted for use with railroad dispatchers. An evaluation process will be developed to assess training effectiveness, and printed course materials and videotape will be disseminated to railroad training organisations. The project has been completed. Final report in process of review.
High-Speed Operator Stress and Fatigue
This project examines workload, stress, and fatigue issues within the special context of high-speed train operations to determine if there is a relationship between train operating speed, sleep loss, and work-rest cycles in producing operator fatigue. High-speed railroad operations cause forms of fatigue and stress that differ markedly from those due to circadian rhythms, sleep loss and work-rest cycles. High speed operations can affect the locomotive engineer in two ways: first, as speed increases, locomotive engineers are exposed to increasing sensory loads because they must scan the track and its fast-flowing vicinity with increasing intensity to detect signals and danger signals. Second, the process of information retrieval (track characteristics, landmarks, the Daily Operating Bulletin, operating rules, etc.) from the locomotive engineer’s memory becomes increasingly intensive with increased speed. Therefore, as speed increases, the workload of information processing and retrieval increases. The project uses the high-speed locomotive simulator developed cooperatively with the Volpe Center and Massachusetts Institute of Technology (MIT) to simulate various information loading scenarios for both locomotive engineers and dispatchers.

High-speed and Freight Locomotive Simulator Research Program
With the mechanical failure of the its locomotive simulator in Chicago, FRA will need to either purchase or lease a locomotive simulator to meet FRA’s research requirements. With the introduction of high-speed rail operation in the U.S., there is also a need to evaluate human factors issues related to high-speed passenger operations. In FY 2000, FRA initiated a project to evaluate the functional capabilities of Amtrak’s Acela high-speed training simulator for use as a research tool. Design modifications were then proposed which would allow the Acela simulator to function as a research tool. As a research tool, however, the Acela simulator would be mostly limited to research on high-speed operations and other cross-cutting issues that bridge both high-speed passenger operations and lower speed freight operations. Consequently, additional options were proposed as part of this study for the design of a research facility capable of simulating different types of locomotives and systems operations (freight operations, passenger operations, PTC systems, communications systems, in-cab displays, etc.) and evaluating the impact of those systems on locomotive engineer performance. There are four functional areas that could be supported by a research facility that included various types of simulation, modeling and computer-aided design:

1. Human factors and operations safety,
2. Track structures, materials and configurations,
3. Train dynamics, and
4. Advanced technologies.

Human factors and operations safety simulation research could support research into safety, usability, user acceptance, and efficiency of various railroad operations technologies, training methods and procedures in a safe environment without risk of injury or property damage. A locomotive simulator, along with a computer-aided design (CAD) software and supporting technologies could be used to design and test track structures, materials and configurations before any ground is broken or track is laid, enabling safe and cost-effective design and analyses. An interdisciplinary simulator research facility could also address train dynamics issues, by studying and modeling different train consists, draft/coupling technologies, and in-train forces to understand how different train dynamics models have on train crews and their performance, leading to safer equipment design and specifications. A state-of-the-art simulator research facility could also examine safety issues related to advanced technologies, such as in-cab displays, communication systems, and other Positive Train Control (PTC) technologies.

The next cycle of work in the high-speed and freight simulator research program will focus on identifying additional simulator research and data needs along those four functional areas, as defined by the industry, and then prioritising those needs. Once these needs have been identified and prioritised through the development of a long-term strategic simulator research plan, recommendations can then be made for a simulator research facility that will accommodate the changing needs of the industry, in both passenger and freight operations. Specific recommendations for a simulator research facility will then be defined, including simulator system architecture, simulator system requirements, operational requirements, data collection requirements, and other physical requirements. Locomotive simulation research is an important component in FRA’s Human Factors Program. This programmatic effort will not only help define the long-term goals of the overall simulator research program, but will also help ensure overall utility and effectiveness of the program to the industry, as well as enhance the performance of the Human Factors Program.

Technology in High-Speed Rail Operations
Since the potential for highly or fully automated locomotive control systems first appeared in 1989, work in this topic area has been underway. The intent of the research in this area is to develop a better understanding of safety-
related implications of various possible automation levels on operator qualifications, training needs, and performance. Preliminary studies have been completed on how human operators respond to varying levels of technical assistance as well as on how they respond to displays showing information about territory further down the track.

Work has concentrated on developing a more refined high-speed locomotive simulator to create more realism in the displays and the operational scenarios under study. Scenarios to be studied include current displays used by locomotive builders and new methods for potential preview displays of the rights-of-way and operational surroundings. How far ahead the operator needs to “see” will be evaluated. Work in subsequent years will address other human factor issues such as maintenance and management of new technologies for operating systems.

**Dispatcher Training Evaluation and Selection**

A project is underway to provide recommendations to the FRA on how the quality, uniformity and efficiency of dispatcher training can be improved. Recommendations on training practices, training standards and the amount of training required, both for the initial training of new dispatchers and for periodic refresher training, were published in a report in FY 1999. Information concerning training performance objectives, syllabi, and test designs will next be used as the basis for recommendations for more effective dispatcher selection. The project has been completed. Final report in process of review.

**Knowledge Display Interfaces**

Knowledge Display Interfaces are one of the component elements of Intelligent Railroad Systems described in Chapter 2 of the 5-Year Plan. In future railroad operations, digital data links and computer displays will be the norms for moving information among locomotive engineers, dispatchers, and traffic managers. Improved ways of displaying information to them to facilitate their comprehension and use of it will be essential if full use of their potentials as well as the potential of the technology is to be realised. This new technology can be expected to increase safety while increasing traffic density and speed if information is shared between decision-makers and operators and acted upon properly. This joint project with Amtrak and the MIT Media Laboratory has two purposes: (1) to evaluate alternative display concepts, and (2) to provide railroads with innovative digital display environments to enable exploration, analysis, and development of strategies to strengthen and coordinate safe decision-making for new higher-speed operations on the Northeast Corridor. Future work will explore implementation of the technology in freight operations in collaboration with an industry partner.

**Crew Resource Management**

Recent studies by the Federal Aviation Administration (FAA) of airline cockpit crews, as well as other studies of surgical operating room staff and other informal teams, indicate that the interactions among the members of such teams is a major determinant of human errors. Teams of professionals assembled to perform a specific task during a limited period of time (fly a jet between two cities, or remove an appendix from a patient) often commit life-threatening errors because of misunderstood roles, faulty expectations, and lack of adequate communication. Train crews—engineer and conductor/brakeman and the dispatcher—are also informal teams, and may suffer from similar problems. Moreover, as the railroad industry continues to modernise, it can be expected that such informal teams will also include maintenance personnel. The objective of this project is to examine the crew interactions that exist in current railroad operations which effect safety and to develop strategies to enhance safety through more effective “teaming.”

**Workload Transition Effects**

Rapid transitions between periods of high workload and low workload are typical of current train operations. Such workload transitions are known to adversely affect situational awareness (knowledge of present place, time, and circumstances) and can result in serious operational errors. The purpose of this project is to determine the extent to which rapid workload transitions affect train-handling performance and to develop strategies to ameliorate this effect.

**Digital Communications**

This project will examine the human factors implications of the use of digital communications among locomotive engineers, roadway workers, and dispatchers. Currently, such communications are conducted by voice; and previous work has shown that voice communications are far less efficient and precise than digital communications. Given current advances in technology, a transition from voice to digital communication is a certainty. This transition, however, is also certain to change the tasks (broadly defined) of locomotive engineers. This project will determine the human factors safety implications of this transition. A transition to digital communications without careful observation of the effect on railroad staff could lead to serious safety problems.
Cognitive Task Analyses of Railroad Occupations

Cognitive task analysis (CTA) is a hybrid methodology that combines field observations with structured interviews to build and progressively refine an understanding of the demands of a job and the knowledge and strategies that are used by experienced individuals to respond to those demands. CTA describes the mental planning of tasks, rather than the physical actions that are carried out. CTA allows the identification of the cognitive skills needed to perform a task proficiently, and is primarily valuable for tasks that depend on cognitive aspects of expertise. Many safety critical jobs (e.g., dispatcher, locomotive engineer) in the railroad industry depend on cognitive expertise, and our ability to understand the human factors safety implications of changes in technology (e.g., digital communications, new displays) or operating practices (e.g., teaming of operating personnel) directly depend on the information that CTA provides. This project will provide basic CTAs for safety critical railroad occupations and specific CTAs, as required, to support other projects, such as the Teaming and Digital Communications project.

Locomotive Cab Working Conditions

In 1992, Congress enacted Section 10 of the Rail Safety Enforcement and Review Act (Public Law 102-365), which required FRA to assess the extent to which environmental, sanitary and other working conditions in locomotive cabs affect productivity, health and the safe operation of locomotives. Subsequently, the Human Factors Program has provided research support to FRA’s Office of Safety and the RSAC on Locomotive Cab Working Conditions in examining the effects of air quality, noise, temperature, vibration and sanitation on locomotive crews. A Notice of Proposed Rulemaking for locomotive cab sanitation has been published, and work continues on other working conditions issues.

Human Factors At Grade Crossings

The following projects all relate to human factors issues at grade crossings.

Post-Accident Stress in Locomotive Engineers

Police officers, firemen, and rescue workers who are involved in responding to serious accidents involving loss of life often experience Post-Traumatic Stress Disorder (PTSD). Mandatory counseling is often provided for individuals involved in traumas. Discussions with locomotive engineers indicate that during the course of a career most locomotive engineers experience a traumatic grade crossing accident. At present there is no uniform industry approach to PTSD in locomotive engineers, although anecdotal information suggests that safety may be compromised if counseling is not provided. This project will determine if the experience of a traumatic grade crossing accident is debilitating and examine the efficacy of standard counseling techniques.

Driver Behavior

The driver behavior project will address a variety of issues concerning the behavior of motorists at grade crossings. The Grade Crossing Research Needs Workshop held in 1995 found that it is unknown why motorists and commercial vehicle operators take risks at grade crossing (e.g., driving around gates, directly in front of trains). Such risk-taking may be correlated with:

- Demographic or sociocultural variables.
- Perceived train speed.
- Perceived distance.
- Credibility of, and warning times for, active devices.
- Sight distance and visibility.
- Driver familiarity with the grade crossing.

Motorists’ and commercial vehicle operators’ perception of risk may be determined by the perceived frequency of trains, and decisions to cross or stop may be critically influenced by perceived costs and benefits associated with each action (including fines for noncompliance). In the absence of clear information concerning the determinants of risky behavior, efforts to change driver behavior may be ineffective. This project will attempt to identify the major variables that cause risky behavior so that a systematic effort to enhance safety can be undertaken. The first component involves the use of driving simulators.