International Rail Safety Conference

2000 LONDON

8 November - 10 November 2000
Forum Hotel, London, United Kingdom

Paper 0000

Index of 2000 Conference Papers

Publisher
2000 International Rail Safety Conference

International Rail Safety Conference

2000 LONDON

8 November - 10 November 2000
Forum Hotel, London, United Kingdom

Index of 2000 Conference Papers

Publisher
2000 International Rail Safety Conference

Paper No.	Author	Remarks
0010	Dr Debbie Lucas	Plenary Session Discussion
0011	Dr Francine Keravel	Level Crossings. Technical Choice based on Car-Driver Behaviour
0012	Ms Kirsi Pajunen	Countermeasures to Improve Safety at Railway Level Crossings
0013	Mike Lowenger	Trespass Prevention - Public Collaboration and Partnerships
0014	Terry Atkinson	Benchmarking of Safety Parameters - Results
0015	Tony West	What Factors Provide a Major Influence on the Performance of the Safety Critical Workforce
0016	Richard Rosser Jon Allen	How Do We Gain and Maintain a Positive Safety Culture and How Do We Measure It?
0017	Tony Blyth	How Do We Gain and Maintain a Positive Safety Culture and How Do We Measure It?
0018	Susumu Chigira Masakazu Takahashi	Building Up Safety Climate as Administrative on Site
0019	Jim Schultz	Co-Management of the Safety Process - How Labour Unions and Management are Working Together to Maximise Safety Improvements at CSX Transportation
0020	Gerad Boqueho Yves Mortureux	Evolution of the Regulatory Framework Governing the Relations between the State and the Various Players Involved in Safety Management on the French National Railway Network
0021	Takeshi Inoue Yashuiro Hasegawa	Technical Deregulation about Railway Enterprise in Japan
0022	George Smallwood	Implementation of Fatigue Countermeasures within the Collective Bargaining Framework
0023	Colin Sellors	Paper for Plenary Session Discussion - Safety in the Supply Chain. Who is Responsible?
0024	Brian Clementson	The Supply Chain - design/components/Rolling Stock and Beyond

Publisher
2000 International Rail Safety Conference

Paper No.	Author	Remarks
0025	Dr Jacob Kam	The Assurance of System Safety for the Hong Kong MTR Network: Modifications and New Extensions
0026	Lim Poo Yam	Implementing Project Safety Review Process - the LTA Experience
0027	Ray Howe	Waipahi train Accident - A Human factors Case Study
0028	Bob Smallwood	SPAD Reduction - Human and Infrastructure Factors
0029	Dave Billmore	GNER Experience of Confidential Incident reporting by Staff (CIRAS)
0030	Hans Ring	Is Railway Safety at Risk?
0031	Stewart Francis	The Passengers View of Rail Safety
0032	Ian Naish	Informing Public Understanding and Expectations on Railway Safety
0033	Bill Casley	CD Project - Report to Delegates
0034	Bill Casley	Paper for Plenary Session Discussion - How Safe is Safe?
0035	Mabila Mathebula	Challenging old Paradigms: New Roles for Railway Safety Managers
0036	Terry Burtch	Improving Safety is NO Accident
0037	Yoshihira Fukushima Hiroyuki Suenaga	Information offering to a train crew - with consideration of human factors -
0038	Extract from the Public Inquiry Report conducted by The Commission appointed to examine the facts of the accident which involved two trains colliding head-on on 4 January 2000 at ASTA, NORWAY. 19 persons were killed and 67 injured.	

Publisher

2000 International Rail Safety Conference

International Rail Safety Conference

2000 LONDON

8 November - 10 November 2000
Forum Hotel, London, United Kingdom

Paper 0001

Programme

Publisher
2000 International Rail Safety Conference

Programme

Day One - 8 November 2000

0830	**Registration & Headset collection**

0900 **Welcome**

Chair - Vic Coleman *HM Chief Inspector of Railways* **HSE, UK**

0910 **Introductory Address**

Vic Coleman *HM Chief Inspector of Railways* **HSE, UK**

0930 **Issues Arising from the Ladbroke Grove Train Disaster**

Rod Muttram *Director* **Railtrack Safety & Standards Directorate, UK**

1000 **Human Factors: Findings from Ladbroke Grove**

Debbie Lucas *Head of Human Factors, Hazardous Installations Directorate* **HSE, UK**

1030 **Incorporating a Human Factors Approach to Investigating Rail Incidents**

Faye Ackermans *General Manager, Safety and Regulation* **Canadian Pacific Railway, Canada**

1100	**Morning Coffee**

1130 **Promoting Human Factors in Rail Safety Management in Australia**

Rob Burrows *Director, Office of Rail Safety* **Department of Transport, Western Australia**

1200 **Some Ways to Control Railway System Interfaces within RATP**

Gerald Churchill *Deputy Director* **RATP, France**

1230 **Lunch**

Chair - Vic Coleman *HM Chief Inspector of Railways* **HSE, UK**

1330	**Do not Blame Responsibility but Investigate Causes – Roles of Management and Unions Challenging for Railway Safety**
	International Joint Union Paper: presented by **Gary Housch** *Vice President* Brotherhood of Maintenance Way Employees (Canada), **Thomas Hucker** *Vice President* Brotherhood of Locomotive Engineers (Canada), **Katsuya Chiba** *General Secretary* East Japan Railway Workers Union (JREU) (Japan) and **Toshio Murata** *Director, Negotiation Department* East Japan Railway Workers Union (JREU) (Japan)
1430	**Plenary Session to discuss the last paper and other issues surrounding the human factor and railway safety**
	Debbie Lucas Head of Human Factors, Hazardous Installations Directorate **HSE, UK**
1525	**Afternoon Tea**
1545	**Level Crossings: Technical Choice based on Car-Driver Behaviour**
	Dr Francine Keravel *Benchmarking & Reliability Advisor* **Reseau Ferre de France**
1615	**Countermeasures to Improve Safety at Railway Level Crossings**
	Kirsi Pajunen VTT Communities and Infrastructure, Finland
1645	**Trespass Prevention – Public Collaboration and Partnerships**
	Mike Lowenger *Vice-President* **The Railway Association of Canada**
1715	**Benchmarking of Safety Parameters – Results**
	Terry Atkinson *Manager, Rail Safety* **Land Transport Safety Authority of New Zealand**
1745	**Summing Up & Close of Day One**
1930 -20.00	**Dinner at Forum Hotel (for those who have confirmed) in Ashburn III**

Day Two – 9 November 2000

08:30	Registration & Headset collection

Chair - Mike Maynard *Strategy & Planning Manager* **London Underground, UK**

09:00 **What Factors Provide a Major Influence on the Performance of the Safety Critical Workforce**

Tony West *Assistant General Secretary* **ASLEF, UK**

09:30 **How Do We Gain and Maintain a Positive Safety Culture and How Do We Measure It?**

Richard Rosser *General Secretary* and **Jon Allen** *Assistant General Secretary* **TSSA, UK**

1000 **How do we Gain and Maintain a Positive Safety Culture and How do we Measure It?**

A.G. Blyth *Deputy Director, Safety* **Eurotunnel, UK**

1030 **Building Up Safety Climate as Administrative Staff on Site**

Susumu Chigira *Chairperson, Administrative Staff Section* and **Mr Massa Takahashi** *Director, Education Department* **East Japan Railway Workers Union (JREU), Japan**

1100	Morning Coffee

1130 **Co-Management of the Safety Process – How Labour Unions and Management are Working Together to Maximise Safety Improvements at CSX Transportation**

James Schultz *Vice President and Chief Safety Officer* **CSX Transportation, US**

1200 **Evolution of the Regulatory Framework Governing the Relations between the State and the Various Players Involved in Safety Management on the French National Railway Network**

Gerard Boqueho *Division Chief* **and Yves Mortureux SNCF**

1230	**Technical Deregulation about Railway Enterprise in Japan** **Takeshi Inoue** Executive Director, **Yutaka Hasegawa** Transport Safety Department Manager, **Yasuhiro Suzuki** Transport Safety Department Assistant Manager, **East Japan Railway Workers Union (JREU), Japan**
1300	**Implementation of Fatigue Countermeasures within the Collective Bargaining Framework** **George Smallwood** Assistant Vice-President, Manpower, Training and Operating Practices **Burlington, Northern and Sante Fe Railway Company, US**
1330	**Lunch**
	Chair – Richard Rosser *General Secretary* **TSSA, UK**
1430	**Plenary Session** **Safety in the Supply Chain: Who is Responsible?** **Colin Sellers** *Department Manager, Safety and Risk Management* **AEA Technology, UK**
1530	**Afternoon Tea**
1600	**The Supply Chain – Design/ Components/ Rolling Stock and Beyond** **Brian Clementson** *Director, Safety and Quality* **Virgin Trains, UK**
1630	**The Assurance of System Safety for the Hong Kong MTR Network: Modifications and New Extensions** **Jacob Kam** *Safety and Quality Manager* **MTR Corporation, Hong Kong**
1700	**Implementing Project Safety Review Process - the LTA Experience** **Lim Poo Yam** *Manager, Safety* **Land Transport Authority of Singapore**
1730	**Summing Up. Close of Day Two**
1830	**Dinner at London Transport Museum** – for delegates who have confirmed. Please collect tickets and directions at registration desk.

Day Three – 10 November 2000

0900	**Registration & Headset collection**
	Chair – Matt Walter *Controller Safety Management Systems* **Railtrack Safety & Standards**
0930	**Waipahi Train Accident - A Human Factors Case Study**
	Ray Howe *Rail Accident Investigator* **Transport Accident Investigation Commission, New Zealand**
10:00	**SPAD Reduction – Human and Infrastructure Factors**
	Bob Smallwood *HM Deputy Chief Inspector of Railways* **HSE**
1030	**GNER Experience of Confidential Incident Reporting by Staff (CIRAS)**
	Dave Billmore *Safety & Loss Control Manager* **GNER, UK**
1100	**Morning Coffee**
1130	**Is Railway Safety at Risk?**
	Hans Ring *Director Safety, Head of the Safety Department* **Swedish National Rail Administration**
1200	**The Passengers View of Rail Safety**
	Stewart Francis *Chairman* **Rail Passengers Council, UK**
✓ 1230	**Information Offering to Train Crew**
	Yoshihira Fukushima *Deputy Director* and **Hiroyoki Suenaga** *Assistant Manager* **East Japan Railway Company**
1300 1200	**Informing Public Understanding and Expectations on Railway Safety**
	Ian Naish *Director RPIB* **Transport Safety Board of Canada**
1330	**Lunch**

Chair - Bill Casley *Director* **Bill Casley Consultants, Australia**

1430	**CD Project - Report to Delegates**
	Bill Casley *Director* **Bill Casley Consultants, Australia**
1435	**Plenary Session** **How Safe is Safe?**
	Lead Presenter: **Bill Casley** *Director* **Bill Casley Consultants, Australia**
1535	**Decision on Conference 2001**
1540	**Overview & Close of Conference: Vic Coleman** *HM Chief Inspector of Railways* **HSE, UK**

International Rail Safety Conference

2000 LONDON

8 November - 10 November 2000
Forum Hotel, London, United Kingdom

Paper 0002

Speaker's Biographies

Publisher
2000 International Rail Safety Conference

Speaker's Biographies

Day One – 8 November 2000

Vic Coleman
Chair
HSE, UK

Vic has been a Government Health and Safety Inspector since 1973. Before joining the Railway Inspectorate in 1990 he had experience of inspection, investigation and enforcement work in a variety of industries, including construction, chemicals, research, engineering etc.

During 1992/3 Vic was involved in leading a team which produced a range of options for enhancing the safety regulatory regime in preparation for the privatisation of and liberalisation of access to British Railways.

Since 1995 Vic has been the HM Deputy Chief Inspector of Railways responsible for field operations and, since 1998, he has been HM Chief Inspector of Railways.

Vic spent three years as a member of the anglo-French Channel Tunnel Safety Authority. He has acted as UK representative at various international standards committees and has also been involved in ILO work. Vic has chaired the Health and Safety Commission's Railway Industry Advisory Committee since 1998.

Rod Muttram
Director
Railtrack Safety & Standards Directorate, UK

Rod Muttram is Director, Safety & Standards, Railtrack PLC and a member of the Railtrack Group Board.

He took up his post on 7 December 1997, having joined Railtrack in January 1994 as Director, Electrical Engineering and Control Systems, following a career spent in the Atomic Energy, Plastics and Defense Electronics industries. Immediately prior to joining Railtrack, he was Director and General Manager of Thorn EMI Electronics' Defence Systems Division.

Mr Muttram graduated in Electronic and Electrical Engineering from the Victoria University of Manchester. He also has a Post Graduate Diploma in Management and a Higher National Certificate in Applied Physics. He is a fellow of the Institution of Electrical Engineers and of the Institution of Railway Signal Engineers. He is also a

Member of the Institute of Directors, the Chartered Institute of Transport and the Institute of Management.

He is married with 4 daughters and lives in Surrey.

Debbie Lucas
Head of Human Factors, Hazardous Installations Directorate
HSE, UK

Dr Deborah Lucas is a Principal Psychologist with the Health and Safety Executive (UK). She currently leads the human factors team of the Hazardous Installations Directorate. She is a Chartered Psychologist with degrees in psychology from the Universities of Bristol and Manchester. Prior to joining HSE she worked for 9 years as a human factors consultant for high hazard industries including the UK rail sector. Her work then included assisting British Rail in investigating the human factors causes of the Clapham Junction accident and in reviewing the ergonomic design of cabs for driver only operation. Over the last 18 months Debbie has given written and aural evidence on human factors to the Southall and the Ladbroke Grove rail inquiries. She has also presented a jointly authored human factors report to the Joint Rail inquiry. Debbie's particular areas of experience include: the modelling of human error in industrial safety, human reliability assessment, and the impact of shiftwork and fatigue on performance. She has also co-edited a book on the role of incident and near miss reporting as a tool for safety management.

Faye Ackermans
General Manager, Safety & Regulation
CPR, Canada

Faye has held a number of positions within the Operating Department at CPR, progressing from a Systems Planning Analyst within the Mechanical Department in 1982 to appointment as General Manager, Safety & Regulatory Affairs in January of 1996. In her current position, reporting to the Executive Vice President Operations, she directs a staff of about 80 and provides all of Operations with a co-ordinated approach to Safety and Regulatory issues, including the prevention of train accidents and personal injuries, managing the outcomes of such accidents, including investigation, claims, FELA and health services. Her department also provides operating regulatory oversight for the company and liaises with government regulators in both Canada and the United States.

Prior to joining the CPR, Faye had a six year career within the pharmaceutical industry in medical research.

Faye has an MBA from Concordia University (1983) in Finance and Strategic Planning and Honours BA in Psychology from Carleton University (1975)

Faye is married to John and they have two daughters ages 17 and 12.

Rob Burrows
Director
Office of Rail Safety
Department of Transport, Western Australia

Rob Burrows is responsible for establishing Western Australia's independent rail safety regulation regime. This included developing the State's rail safety legislation and establishing the Office of Rail Safety.

Rob Burrows is Chair, Accreditation Authorities Group of Australia (the meeting of State rail safety regulators) and Chair, Rail Safety Consultative Forum of Australia (meeting between State rail safety regulators and senior safety managers of rail companies in Australia).

He is also author of the Report to Australian Transport Ministers: "*Independent Investigation and Open Reporting of Rail Occurrences in Australia*" 1998.

Gerald Churchill
Deputy Director
RATP, France

Gérald Churchill is a graduate Engineer, from the "French Electricity Engineering School".

He joined the RATP in 1978 as a rolling stock maintenance Engineer. Subsequently, he was successively a rolling stock design Engineer, a new rolling stock project Manager, a Supervisor of vital software validation, RAMS studies and audit, above all in the field of railways safety.

In the 1995, he was appointed as the associate of the Chief Electrical Engineer in charge of co-ordination, development and technical consistency.

He is presently Deputy Director of the Department in charge of the engineering, maintenance and validation of signalling, ATO/ATP/ATS, and energy supply equipment on the RATP network.

Gérald CHURCHILL was a member of different European standardisation working groups, in particular the RAMS standard (EN50126) and a member of the Board of the French Railways Certification Agency CERTIFER.

He is presently the French speaker of the European sub committee SC9XA for signalling and telecommunication and RATP representative in the " Electrical Installations and Safety System " of the UITP.

He is a "fellow member" with the IRSE (Institution of Railways Signal Engineers).

Gary Housch
Vice President
Brotherhood of Maintenance Way of Employees, Canada

Gary Housch is an International Vice President of the Brotherhood of Maintenance of Way Employees, a union that represents more than 45,000 rail workers in Canada and the United States. Originally from Hanna, Alberta, Housch first became a full-time officer with the BMWE in 1987 when he was elected to represent employees of Canada's major rail carriers in Alberta. In 1990, he was elected to the position of Vice President and moved to Ottawa out of the BMWE's national office. Since then, he has been very active in the rail industry and has been deeply involved with transportation issues in general. In 1992, he was named a Canadian representative to the ILO in Geneva, Switzerland. In 1995, he was appointed to the Governor General's Canadian Study Conference and as a member thereof toured the country.

Thomas George Hucker
Vice President
Brotherhood of Locomotive Engineers, Canada

After University, where he studied History and Political Science in a Bachelor of Arts program George Hucker joined Canadian Pacific Railway in 1966 as a trainman/yardman. During the late 1960's and early 1970's he worked in different locations for CP Rail. He qualified as a Locomotive Engineer in 1975 in the first Locomotive Engineer training program at CP Rail in Thunder Bay, Ontario.

George Hucker joined the Brotherhood of Locomotive Engineers in 1975 and was first elected in 1980 as Local Chairman of Division 243, Thunder Bay, Ontario. In 1986, he was elected General Chairman, headquartered in Calgary, Alberta, for the General Committee of Adjustment for CP Rail HH, representing Locomotive Engineers from Thunder Bay to Vancouver Island. As the General Chairman, he was required to negotiate and administer the Collective Agreement for Locomotive Engineers employed by CP Rail in Western Canada.

In 1993, he was elected International Vice President and National Legislative Representative, headquartered in Ottawa, Ontario. As the National Legislative Representative of the BLE he is required to handle all federal legislation affecting the transportation industry in Canada. His duties as a Vice President requires that he act as the chief negotiator for national negotiations with CP Rail and Regional negotiations with the Algoma Central Railway.

International Brotherhood of Locomotive Engineers

Profile
The International Brotherhood of Locomotive Engineers (BLE) represents locomotive engineers, train dispatchers and rail traffic controllers in North America's $36 billion revenue rail industry. BLE total membership is nearing 55,000. Headquartered in

Cleveland, Ohio, the union also maintains national legislative offices in Washington, D.C. and Ottawa, Ontario.

Through its local, national and international entitle, the BLE concentrates in two areas; collective bargaining and freight and passenger train safety. BLE local units are known as Divisions, each with four elected officers: President, Local Chairman, Secretary-Treasurer and Legislative Representative.

Local Chairmen on a railroad constitute a BLE General Committee of Adjustment. A General Committee autonomously negotiates, interprets and upholds contracts with its railway. Legislative representatives within a state or province comprise a BLE State/Provincial Legislative Board. A legislative board educates policy and lawmakers concerning the impact of transportation regulations on employee and public safety.

In 1993, the 2,000 member American Train Dispatchers Association merged into the union, becoming the American Train Dispatchers Department of the BLE. In 1996, the 700 member Rail Canada Traffic Controllers merged into the union.

Founded in 1863, the BLE is the senior national labour Organization in the U.S., and North America's oldest rail union.

Katsuya Chiba
General Secretary
JREU, Japan

Katsuya Chiba was born in Mizusawa City, about 500km north of Tokyo. After graduating from high school he worked for Isuzu, a car manufacturer in Japan. In 1974, he joined the former Japan National Railways and worked in the Shintsurumi locomotive train depot, one of the main freight yards in Tokyo metropolitan area, as a maintenance worker, then became an electric locomotive engineer.

When entering former JNR he joined the National Railway Motive Power Union. He became a leader in his workplace and was elected as a chairperson of the union's youth section in 1984. When the former JNR was privatized in 1987 he was transferred to the Shinagawa drivers depot in Tokyo as an electric train driver. After one and a half years of service he was again transferred to the Shinagawa conductors office as a conductor. In 1994 he was elected as an executive board member of the Tokyo district office and in 1996 became a full-time officer in the JREU headquarters. In July 2000 he was elected General Secretary. He is one of the union experts regarding railway safety.

Toshio Murata
Director, Negotiation Department
JREU, Japan

After graduation from Oji Technical high school, majoring in electronics Toshio Murata joined the former Japan National Railways in 1978, working in the Tabata signal and communication office in Tokyo as an electrician.

He was elected as a full-time union officer in Tokyo district office in 1989 and elected as an executive board member of JREU headquarters in 1998.

He has worked in the Negotiation department as a tough, experienced negotiator. He has good knowledge of railway safety, especially, electric, track maintenance and construction.

He is a father of three boys and likes golfing and snow skiing.

Dr Francine Keravel
Benchmarking & Reliability Advisor
Reseau Ferre de Ferre, France

Dr Francine Keravel has worked as *« Benchmarking and reliability Advisor »* for Réseau Ferré de France since 1998.

Prior to this, she spent 20 years working for SNCF in a variety of different roles: in occupational medicine, as a Research Laboratory Director, as a Medical Ergonomic Advisor and as a Reliability expert for General Delegation on safety.

She has a Doctorate in Medicine (PhD) is a specialist in occupational medical work and ergonomics, a European Master in dependability and an Expert for the International Electrotechnical Commission (IEC).

In addition she is Chairwoman of the «Human reliability Group » for European Safety Reliability and database (ESReDA) and Chairwoman of « Human Factors Feedback experience Group » for the French Reliability Institute.

Kirsi Pajunen
VTT Communities and Infrastructure, Finland

VTT Communities and Infrastructure is the Technical Research Centre of Finland including under its auspices communities and infrastructure and transport and urban planning.

Kirsi is involved in road traffic safety research (traffic conflict studies, accident analysis, traffic behaviour) and is at present administrating two EU-projects (speed management and enforcement). She is now acting as EU-project co-ordinator at Transport and Urban Planning.

Kirsi has been involved in railway safety research since 1996 including statistical analysis, traffic control, risk analysis and railway level crossings.

Mike Lowenger
Vice President
Railway Association of Canada

Mr Lowenger was born in Montreal, Quebec, in 1950. He graduated from McGill University in 1973 with a degree in Mechanical Engineering.

Mike began his railway career in 1974 with the Canadian National Railways. In his 25 year railway career, he has held several senior management positions across Canada and has extensive knowledge of railway operations, particularly in plant maintenance and construction.

Mike held the position of District Engineer in Saskatoon, Saskatchewan between 1983 and 1990. He was also Chief Engineer of the Toronto Terminals Railways in 1990-1992 and the director of Safety and Regulatory Affairs for CN in Montreal between 1994 and 1998. Mike was appointed to his current position of Vice-President of the Railway Association of Canada (RAC) in November 1998.

Mike's prime responsibilities with the RAC include coordination of rule making for member railways, safety advocacy and general industry support in the areas of safety, regulatory affairs and Transportation of Dangerous Goods.

Mike is married with two children.

Terry Atkinson
Manager of Rail Safety
Land Transport Safety Authority of New Zealand

During a career of 39 years in the railways, Terry has worked for four major railways in four countries, attaining senior managerial positions and worked as a consultant to the railway industry in the United Kingdom, Australia and New Zealand. He is currently working with the Land Transport Safety Authority – a New Zealand Crown entity and is responsible for the control and monitoring of safety within the railway industry. This comprises over seventy separate railway undertakings including four tramways, several heritage railways and over thirty industrial railways as well as the main privatised railway network in New Zealand – Tranz Rail Limited.

He is a qualified Civil Engineer. The mid-part of his working life was spent largely working in the area of permanent way engineering, although his senior management positions have encompassed all aspects of infrastructure engineering and railway operations.

More recently in line with his present responsibilities, he has turned his attention to the regulation issues associated with the maintenance of railway safety, in an industry experiencing extremely volatile change, and has become a champion of the need to be able to measure safety performance through statistical comparison. He is the author of several papers on this subject presented mainly in Australia and New Zealand.

Mike Maynard
Strategy & Planning Manager
London Underground, UK

Mike Maynard is General Manager of the Safety Quality and Environment Department within the recently reorganised London Underground. In this role he has particular responsibility for Safety Strategy and Planning, and for providing front line safety support to the operational railway.

Prior to joining London Underground in 1994, Mike worked for 5 years in the Health & Safety Department of Nuclear Electric, which at that time operated all the nuclear power stations in England and Wales. Here he was heavily involved in developing the principles and guidelines for the safety review of existing operational plant, and was a member of a European power utilities working group which produced safety requirements for future nuclear power reactors.

Earlier in his career Mike was a Principal Engineer with a firm of Consultant Nuclear Engineers.

Tony West
Assistant General Secretary
ASLEF, UK

Tony has worked in the railway industry since 1955.

He became Assistant General Secretary of ASLEF in1994 and was prior to this District Secretary, British Rail ASLEF Local Level Representative (LDC), British Rail ASLEF Sectional Council Member and ASLEF Representative on various bodies, including Labour Party Conferences and TUC.

As an ASLEF District Secretary and Assistant General Secretary, Mr West has attended many Train Operating Company Joint Safety Committee's, London Underground Safety meetings, Railtrack Safety meetings, and meetings with the HMRI on behalf of the Society.

He has represented Members at Industrial Tribunals, Coroners Courts, Disciplinary Hearings, Medical Tribunals and Department of Health Appeals.

He was Parliamentary Candidate for the Labour Party, Gillingham, Kent in 1983 and Labour Party Councillor for London Borough of Bexley for 5 years.

He is a Trustee of the Railway Pension Scheme and a Board Member, Transport for London.

Richard Rosser
General Secretary
TSSA, UK

Richard Rosser has been General Secretary of the 31,000 strong Transport Salaried Staffs' Association since 1989. He is a member of the TUC General Council, and from 1988 to 1998 Richard was a member of the Labour Party's National Executive Committee and was Chairman of the Labour Party 1997/98.

Previously, from 1971 to 1978 he was a Councillor for the London Borough of Hillingdon and Chairman of the Finance Committee from 1974 to 1978. Richard was a parliamentary candidate for Croydon Central in 1974. He was appointed a Justice of the Peace in 1978 and is currently Chairman of the Uxbridge Bench.

Richard recently became a Non Executive Director of the Strategy Board for Correctional Services. He is a member of the Institute of Logistics and Transport.

Jon Allen
Assistant General Secretary
TSSA, UK

Jon Allen was appointed Deputy General Secretary of the 31,000 strong Transport Salaried Staffs' Association in 1998.

He is a member of the Central Arbitration Committee.

Jon started his career as a fire-fighter whilst lecturing part time on TUC Health & Safety courses.

Jon left the fire service to join the National Union of Civil & Public Servants (NUCPS) becoming a Negotiations Officer, and in 1992 joined the TSSA as a Divisional Officer.

Jon has been active in the Trade Union movement since 1977.

Jon is an active member of the Labour Party and was a member of Brighton Borough Council From 1986 to 1994 serving as Chair to the Personnel Committee and Chair of the Public Safety Committee.

Tony Blyth
Deputy Director (Safety)
Eurotunnel, UK

Tony Blyth in his role as Deputy Director (Safety) reports to and deputises for the Safety Director. He is responsible for providing proactive leadership expertise and advice to the corporate and line functions. He provides strategic advice to board members, directors and senior managers on improvements to policy and systems and lectures on aspects of Safety Management, Risk Management and Emergency Planning.

Tony joined TML, the Channel Tunnel contractors, in 1987 where he became involved in emergency planning and establishing probably the most extensive underground communications and monitoring system ever installed in an underground environment He joined Eurotunnel's operation team in 1991 and moved to the Safety Directorate in 1994. He was a member of the panel of Inquiry into the 1996 Channel Tunnel fire and managed the research into fire development that followed.

Susumu Chigira
Chairperson
JREU, Japan

Susumu Chigira entered the former Japan National Railways and worked in the Omiya track maintenance depot in 1970. He became assistant general manager at the Oyama track maintenance depot in 1985, then promoted gradually to become a deputy station master at the Ikebukuro Station in Tokyo.

After privatization of the former JNR in 1987, station masters from small stations and deputy station masters joined the union and an administrative staff section organization was formed. The station masters are managers but workers as well, so they protect their specific benefits, such as working conditions and safety issues through participating in trade union activities.

Mr Chigira has taken an important role in this organization. He has been an executive member of the administrative staff section in the headquarters since 1990 to protect his colleagues' benefits. Of course he is a good manager as well.

Massa Takahashi
Director, Education Department
JREU, Japan

Masakazu Takahashi was elected as an executive board member of JREU in July, 2000. He entered the trade union movement in 1979 joining the National Railway Motive Power Union as a secretary. When JREU formed he was a secretary of the International Department.

He prepared for the first International Railway Safety Conference in 1990 and Asian Railway Safety Conference in 1993 held in Tokyo, which were co-sponsored by union and management of JR East. He has taken part in the IRSC since 1994. He has created international solidarity activities for his union.

James Schultz
Vice President and Chief Safety Officer
CSX Transportation, US

Schultz's railroad career started in 1980 with the former Chicago and North Western Railway where he served as trainmaster, safety officer, director special projects, and qualified locomotive engineer. He worked 11 years for the Federal Railroad Administration, holding positions from safety inspector to Associate Administrator for Safety. As Vice President at CSX Transportation, he is responsible for company safety programs, including employee safety, train safety, records, investigations, hazmat, public safety, grade crossing safety, operating rules and testing, engineer training, and operating practices support.

Gerard Boqueho
Division Chief
SNCF, France

Gerard Boqueho has worked for SNCF since 1972.

Having held several managerial positions, he moved to the "Systemes d'exploitation et securite" Department in January 2000. He was recently promoted to Division Chief.

He is responsible for safety regulation in the French Railways and is also responsible for monitoring the level of global safety systems.

Yves Mortureux
SNCF, France

Mr Mortureux was born in 1956. He is a civil engineer. He took his first job in SNCF as station head. He then became RAMS (or a dependability) specialist. He has been in charge of this field at the Research Department, then at the Human Factor Department and now at the Center for Safety Studies (CES) in the Opening System and Safety Department (IVS).

Takeshi Inoue
Executive Director
JREU, Japan

Mr Inoue was borne on 17th November 1946. He was educated at the University of Tokyo, Faculty of Technology and Electrical Engineering, gaining a BA in Engineering.

Mr Inoue joined the Japanese National Railways (JNR) in July 1969, holding a variety of managerial positions before becoming in June 2000 Executive Director, Railway Operations Headquarters: Transport Safety Department; Credit Card Department and IT (Information Technology) Business Project Department.

Yasuhiro Suzuki
Assistant Manager of Transport Safety Department
JREU, Japan

Mr Suzuki was born on 27th June 1955. He was educated at Tokyo Economics University, Faculty of Business Administration. He gained a BA in management.

Mr Suzuki joined Japanese National Railways (JNR) in April 1978.

He was Assistant Manager, Transport Safety Department, Railway Operations Headquarters before becoming in February 1996, Deputy Manager, Transport Safety Department, Railway Operations Headquarters.

George Smallwood
Assistant Vice President
Manpower, Training & Operations Practices
Northern and Santa Fe Railway Company. USA

George began his railroad career as a brakeman/conductor on the former Santa Fe Railway Company in 1973 in Winslow, Arizona. He was soon promoted to locomotive engineer. In 1983, George accepted a management position as Road Foreman of Engines at Gallup, New Mexico. His assignments later included General Road Foreman of Engine/Supervisors of Air Brakes, Manager of Train Handling, Manager of Operating Standards and practices, Director of Technical Training, Terminal Superintendent, Division Superintendent and his current position. Concurrent with his railroad endeavours was a commission in the United States Army Reserve as a Transportation Officer.

George attended the University of Tennessee at Chattanooga and is currently pursuing an MBA at Texas Christian University in Ft. Worth, Texas. He resides in Flower Mound, Texas with his wife, Rebekah.

Colin Sellers
Department Manager
AEA Technology, UK

Colin Sellers is a Chartered Engineer and Member of the IEE. He began his engineering career in 1982, with Fogarty plc, designing Control & Instrumentation systems for degassing and deodourising equipment. The equipment, used for degassing transformer oil, amongst other things, utilised porous heating element technology and very high vacuum systems.

He moved to British Gas, in the Research & Development department, where he was responsible for the development and implementation of safety and reliability techniques for microprocessor based control systems. Whilst there he was engaged in the production of safety and reliability assessments of both electronic and microprocessor-based devices used in a variety of control applications for safety critical applications.

He also undertook the development of innovative techniques for the accelerated life and reliability testing of microelectronic and microprocessor based systems, and the development of formal and structured methodologies for the design of control systems used in safety critical applications.

He left British Gas in 1991, working as a consultant providing safety, reliability and risk management services to a number of clients in a variety of industries including, rail, oil & gas, process and electronics.

He joined British Rail Projects, Risk Assessment Group, in 1995, where he was responsible for managing the production of Signalling Interference Safety Cases for Eurostar Trains. These were more colloquially known as the EMC Safety Cases. In recognition of his success in managing these projects, he was appointed Manager of the Safety & Risk Management Department This happened at the same time of British Rail Projects privatisation and rebranding as Transportation Consultants International (TCI). Colin oversaw the development of a fast growing department, providing Business, Project and Safety risk services, in which he had responsibility for all business activity.

The role of the department has since increased to include the provision of strategic decision-making advice, based on risk assessment processes, to, amongst others, LUL PPP Bidders, organisations seeking new TOC Franchises, manufacturers, financiers and lessors and other support service providers.

Brian Clementson
Director
Safety & Quality
Virgin Trains, UK

Brian Clementson is a Chartered Engineer, Fellow of the I Mech E and past chairman of the Railway Division.

Having been in the rail industry for 40 years, he has experienced the transition from public to private ownership.

In the few years prior to privatisation he was Director, Engineering for Trainload Freight, Director Fleet Engineering Intercity, Engineering Director Porterbrook Leasing and Managing Director Railtest.

Soon after Virgin Trains won the West Coast and Cross Country franchises he became Engineering Director. After transferring depots and staff to Virgin's new train suppliers, he was appointed Director of Safety and Quality.

Recently, Brian became Engineering Safety Advisor, with a view to retirement early in 2001!

Jacob Kam
Safety & Quality Manager
MTR Corporation,Hong Kong

Jacob Kam started his career in Ove Arup and Partners, the Consulting Engineers in Hong Kong and UK. He then worked as a research assistant in 1984 and then a lecturer in University College London where he also obtained his Doctorate in fatigue reliability and risk based management of structural systems.

He then joined the UK Health and Safety Executive as a Senior Specialist Inspector in the Offshore Safety Division, taking part in developing the new statutory framework for ensuring safety in the offshore oil and gas industry. He was also a member of the team that developed the assessment approach for Offshore Safety Cases and other safety submissions under the new legislation. By 1993, he was the Head of Offshore Structural Safety.

He joined MTR Corporation in Hong Kong in 1995 and was Safety Programme Manager, Safety Audit Manager, System Assurance Manager (Project) and is now the Safety and Quality Manager. He is now responsible for all safety management and quality management matters of the existing railway network and new MTR extensions.

Previously as the System Assurance Manager (Project), Jacob was responsible for assuring the operational safety and reliability of all new extensions including the HK$ 35 billion Airport Railway which opened in 1998.

Dr. Kam is a Chartered Engineer and a professional member of various Institutions. He has published around 90 articles in international technical journals and conferences. He also has an MBA from Kingston Business School, U.K.

Lim Poo Yam
Manager
Safety
Land Transport Authority of Singapore

Mr Yam started work in the railway industry in 1985, joining Mass Rapid Transit Corporation (MRTC) as an M&E System Planning Engineer. He was involved in the construction of the Phase I, IA, IIA and IIB projects. In 1989, he left for Taipei, joining the American Transit Consultants as the Lead Scheduler. He was the advisor for the Department of Rapid Transit Systems (DORTS) from June 1989 to December 1994. During that period, Brown, Red, Blue, Green and Orange lines were constructed. In 1994, he left Taipei for Hong Kong, joining the Mass Transit Railway Corporation (MTRC) as the Senior Planning Engineer, for the construction of the Lantau Airport Railway Project. He was responsible for Programme Management of the Signalling Contracts and at the same time managed the Track Related Installation Programme (TRIP) from its commencement in July 1996 until April 1998.

Mr Yam joined the Land Transport Authority of Singapore as the Senior Planning Engineer. One year later, he was transferred, and promoted to be the Manager of the Safety Department.

Dr Matt Walter
Controller, Safety Management Systems
Railtrack Safety & Standards

Matt Walter_is the Controller Safety Management Systems in the Safety & Standards Directorate, Railtrack PLC.

He took up this post in March 1998, having initially joined Railtrack in August 1993 as the Head of Safety Validation, following a career spent mainly in the safety and engineering sectors of the nuclear, oil/gas, chemical and transport industries. Immediately prior to joining Railtrack, he was a Board Director of Electrowatt Engineering Services Ltd, a UK subsidiary of the Swiss based EWI Group.

Dr Walter graduated in Mechanical Engineering from the University of Leicester and also has a PhD gained from research into the time dependent behaviour of complex structures. He is a Chartered Engineer, a Fellow of the Safety and Reliability Society, and a Member of the Institute of Nuclear Engineers, the Institution of Occupational Safety and Health and the Chartered Institute of Transport.

He is married with a son and a daughter and lives in Cheshire.

Ray Howe
Rail Accident Investigator
Transport Accident Investigation Commission, New Zealand

Ray is a civil engineer with 30 years experience with New Zealand Railways. He was at various times Plant Engineer, District Engineer, Director of Electrification for the 25 KV electrification of the North Island Main Trunk and the Manager Track.

Since leaving New Zealand Railways in 1988 Ray has worked in Sydney and London as part of a consultant service to City Rail, British Rail, and London Underground. During this period he was particularly involved in developing and implementing risk assessment techniques to prioritise work programmes within resource restraints.

In 1995 the call of home saw him take up his current position as Rail Accident Investigator with the Transport Accident Investigation Commission.

Ray is married with three children and numbers bridge, bowls and still trying to explain the All Blacks current form amongst his relaxations.

Bob Smallwood
HM Deputy Chief Inspector of Railways
HSE

Dr Smallwood joined HSE in 1976 and specialised in the application and use of risk assessment in hazardous industries. He spent two years on secondment to the Atomic

Energy Authority as technical adviser on a major risk assessment project for the Ministry of Defence and also led a specialist team for five years in HSE's Major Hazard Assessment Unit.

Bob Smallwood joined HM Railway Inspectorate (HMRI) in 1994 as Deputy Chief Inspector to establish a Safety Case Assessment Unit and to advise on the application of Risk Assessment in the Railway Sector. He also led HMRI's Research activity and advised on special projects, eg. the Appraisal of ATP and the use of Cost Benefit Analysis. In July 1998 he took over the Head of HMRI's Operations Division and is responsible for all enforcement activity and advice on operational Railway Safety Issues. He is also responsible for leading and coordinating all major investigations of Railway Accidents by the Inspectorate. Bob maintains his interest in Risk Assessment and is a member of the Society for Risk Analysis.

David J.S. Billmore
Safety & Loss Control Manager
GNER, UK

David joined GNER in 1996 when Seacontainers won the franchise to run train services on the East Coast Main Line.

Previously he was Safety Systems Manager with Intercity East Coat, (part of BR); Production Manager Petroleum in the freight business; and ten years as an Area Maintenance Engineer at a variety of locations.

In his current position he is Professional Head of Occupational Health and Safety for GNER.

He is a member of the Institution of Mechanical Engineers, the Institution of Occupational Safety and Health, the International Institute of Risk and Safety Management and the Institute of Logistics and Transport

Hans Ring
Director Safety
Swedish National Rail Administration, Sweden

Hans Ring is a graduate from the Royal Institute of Technology in Stockholm with a Master of Science Degree in systems engineering. Later he assisted Professor E. Andersson in developing the first student course in railway systems.

He joined the Swedish State Railways in 1982. In 1988 the SJ was split up into a train operating company and an infrastructure manager. Shortly after that Hans Ring was appointed Senior Director on the Director General's Senior Staff.

In 1995 he was appointed Chairman of the Swedish Delegation for Safety at Rail-Road Crossings.

In January 1998 there was a corporate reorganisation and Hans Ring was then appointed Head of the new Safety Department, responsible for traffic safety and electrical safety.

The new Safety Department is responsible for safety strategies and policies, for the safety management system within the company and for giving advice on safety related matters to company units as well as to train operating companies on the national railway network.

Stewart Francis
Chairman
Rail Passengers Council, UK

Stewart Francis is Chairman of the Rail Passengers Council.

In addition, Stewart is Chairman of three commercial radio stations in Peterborough, Cambridge and Kings Lynn, and is a Partner of Francis Vincent Media, a sponsorship company. He is a non-executive member of Cambridgeshire Health Authority.

Previously, he was Chief Executive of Business Link Greater Peterborough, Chairman and Managing Director of Mid Anglia Radio plc. and Chairman of the Commercial Radio Companies Association.

Stewart is an award-winning radio broadcaster and has raised £1.5 million for local disability charities.

Yoshihira Fukushima
Deputy Director
East Japan Railway Company

Mr Fukushima was born on 28th September 1950. He was educated at Tokyo Institute of Technology, Faculty of Technology and Mechanical Engineering gaining a Bachelor of Engineering.

Mr Fukushima joined the Japanese National Railways (JNR) in April 1975.

Mr Fukushima has held a variety of managerial positions at JNR before becoming in June 2000 Deputy Director, Safety Research Laboratory.

Hiroyuki Suenaga
Assistant Manager
East Japan Railway Company

Mr Suenega was born 24th December 1965.

He was educated at Nihon University, Faculty of Technology, Mechanical Engineering. He gained a Bachelor of Engineering.

Mr Suenega joined the East Japan Railway Company in April 1988. From February 1996 – February 1999 he was Assistant Chief, Sendai Driver's Office.

He is presently Assistant Manager, Safety Research Laboratory.

Ian Naish
Director RPIB
Transport Safety Board of Canada

Ian Naish obtained an undergraduate degree in Civil Engineering from London University, a Masters degree in Transportation Engineering from the University of New Brunswick and a Masters degree in Business Administration from the University of Western Ontario.

He has occupied various regulatory positions in the rail safety area over the past fifteen years, most recently as Director of Investigations in the Rail and Pipeline Investigation Branch of the Transportation Safety Board of Canada.

Bill Casley
Director
Bill Casley Consultants Pty, Australia

Bill is a professional engineer whose career in public service has spanned some 47 years within the Australian Railway Industry. In 1992, Bill was seconded from the New South Wales' State Rail to the Department of Transport to formulate and establish major new rail safety legislation for NSW.

During his 7 years with the NSW Department of Transport, he was at the forefront in the establishment of rail safety legislation and rail safety regulatory practice within Australia.

Since his retirement from the Department of Transport, he now works as an independent consultant, providing safety management support to developers, contractors and operators in the railway industry.

In response to a number of inquiries regarding the availability of previous conference papers, the delegates to the 1999 Tenth Conference in Banff, authorised Bill Casley and John Hall (NSW Department of Transport) to coordinate the establishment of the CD Project. His paper represents a report to delegates on progress of this project.

International Rail Safety Conference

2000 LONDON

8 November - 10 November 2000
Forum Hotel, London, United Kingdom

Paper 0003

Victor Coleman

Introductory Address

Note: *This was a verbal presentation, accordingly as such there is no written paper.*

Publisher
2000 International Rail Safety Conference

International Rail Safety Conference

2000 LONDON

8 November - 10 November 2000
Forum Hotel, London, United Kingdom

Paper 0004

Rod Muttram

Issues Arising from the Ladbroke Grove Train Disaster

Publisher
2000 International Rail Safety Conference

International Rail Safety Conference

Rod Muttram

Director

Railtrack Safety & Standards Directorate, UK

Issues Arising from the Ladbroke Grove Train Disaster

ISSUES ARISING FROM THE LADBROKE GROVE TRAIN DISASTER

Introduction

The morning of 5 October 1999 was bright and sunny, exceptionally so, many afterwards remarked on the cloudless sky, the clarity of the air and the unusual intensity of the low sun. However, events that morning turned it into one of the darkest days in British railway history.

At just after eight o'clock that morning a three car diesel multiple unit operated by Thames Trains collided head-on with a diesel powered high speed train operated by First Great Western at Ladbroke Grove, a short distance outside Paddington Station in West London. The collision speed has since been estimated to have been in excess of 200 kph. The effect was devastating. The front coach of the DMU was totally destroyed, and the ejected diesel fuel, both from this and the HST power car, caused a huge fireball. One of the MKIII coaches of the HST was subsequently burnt out in a resultant secondary fire. 31 people, 29 passengers and the two drivers were killed, hundreds were injured, some very seriously with both collision injuries and burns.

Whilst the immediate cause of the accident was known within a few hours, the Thames Train had passed a signal at Danger, the contributing system and detail failures were many and complex. Some did not emerge until many months later in the latter stages of Part One of the public inquiry which the Government set up after the accident. Indeed more facts may still emerge from ongoing research. As this paper is written, just after the first anniversary of that terrible disaster, that public inquiry has not reported. Part Two of the inquiry, to look at the industry's safety management systems and structure is just about to start. It would be wrong to pre-empt the findings of that inquiry, and this paper will not attempt to do so. However, many other resultant inquiries, including the industry formal inquiry into the accident, have been completed and have reported. Some of the immediate lessons can be shared with international colleagues. Indeed it would be wrong to hold this conference in London and say nothing about this accident which has rightly been called a 'watershed' for safety in the UK rail industry.

Finally, in this introductory section, mention must be made of the derailment at Hatfield which occurred just as this paper was being finalised. Whilst investigations are at an early stage it is already clear that the accident was initiated by a broken rail. This serves to remind us that railway safety is about managing many and all risks, and in particular all those with catastrophic consequences. After the accident at Southall in September 1997, which tragically killed 7 people and was also the result of a Signal Passed at Danger, and Ladbroke Grove just over two years later; with effectively three public inquiries into these accidents completed and a fourth about to start; the entire focus of public, media and political debate about railway safety has been centred on SPADs and which train protection systems should be chosen for the UK network.

ATP preventable risk is about 5% of total railway risk in the UK. Many other risks must also be proactively managed and it is to be hoped that the immense focus on SPAD management has not taken people's eyes off some of these other risks. A first lesson we have all learned over the years is that our focus should be on preventing the next accident and that will probably not have the same root cause as the last.

The Lessons Already Learned

The aftermath of the accident at Ladbroke Grove saw a huge amount of media attention. With 24 hour news, and multiple news channels, the very rarity of a railway accident makes it newsworthy as well as its scale. The change of Government since privatisation of the industry and the controversial nature of both the privatisation itself and the structure adopted added to the interest and the temperature of the debate. Multiple lines of inquiry were started. As well as the public inquiry to be chaired by Lord Cullen, many other investigations or reports were called for Apart from Lord Cullen's public inquiry most have now reported. The list below is not necessarily exhaustive but covers the major reports :-

- The Industry Formal Inquiry into the Ladbroke Grove Accident
- The HSE report into Railtrack's safety management systems
- The review into the positioning and role of Railtrack's Safety & Standards Directorate (The Rowlands Review)
- The Du Pont report into safety in the UK Rail Industry
- Sir David Davies report into Train Protection Systems.

These reports have already generated over 300 recommendations leading to more than 500 actions. The industry is struggling to resource these, even before the various public inquiries report.

So the first lesson is that an accident such as this places huge demands on the industry. With modern expectations of safety performance from the privatised industry the costs of certain failures, both in financial and reputational terms has become immense. Whilst the industry continues to be accused by the media of putting profits before safety I believe, in truth, it will do virtually anything in its power to avoid an accident which results from a failure of its equipment, people or processes. Whether some of the expenditure which will now result can be justified in overall societal benefit terms is for others to judge. For the industry it is now a matter of survival.

Similarly for the politicians. The previous Government decided to abandon the programme to fit nation wide ATP to Britain's railways because its costs far exceeded its benefits. The advice on which it took that decision was the best available. The HSC and HSE supported it as did a raft of the best safety academics in the world. The money would save many more lives spent on other things such as road safety or the health service. That remains the case. But the media and thus public opinion was simply not prepared to accept high profile accidents occurring for which a remedy, however expensive, was available. In terms of public perception, if not legally, it was as if the risk moved from the 'tolerable' region of the HSE's 'tolerability of risk' spectrum to the 'intolerable' Submissions from all parties to the joint inquiry saw moving to ATP based on the new European ERTMS standards as the right long term solution. Differences of opinion were confined to the route and time scales to achieve this. Organs of the Government have committed to fund the recommendations from the joint inquiry into train protection systems, whatever they may be. So the next lesson is that what constitutes tolerable and intolerable in safety terms cannot be measured simply by equating costs and benefits, and the most academically correct advice in the world will not help if an accident occurs which a different decision could have prevented. Deciding how to spend limited resources on alternative safety improvements which cannot all be afforded will become increasingly difficult. European level action on safety decision rules is desperately needed and is being pursued.

The third major lesson is the need for independent accident investigation. I believe this is now recognised by all in the industry with only the HSE resisting. Whilst collaboration between the HSE, the BT Police and Railtrack on the site has progressively improved between Southall, Ladbroke Grove and Hatfield, the overall process remains deeply unsatisfactory for a number of reasons. The adversarial, court room, nature of a judicial inquiry is simply not the best way to establish the facts of an accident. At Ladbroke Grove Part I many hours were spent debating the configuration, position and sighting of the now infamous signal SN109. Yet it was only in the last few days that evidence emerged which appears to show that, whatever the root or underlying causes, the driver of the Thames Train had started to drive incorrectly at the earlier SN87 signal, the sighting of which is close to the maximum attainable under any circumstances. Rail needs the same arrangements as for air, where the clear separation between the AAIB and the CAA has great strength. The ability of an independent accident investigator to examine the role of the Regulators in the accident, and the ability to dispassionately establish the facts before any blame allocation or prosecution processes start are just two of the strengths of such a system.

The final lesson I would wish to bring out is that losing a reputation is far easier than winning one. Despite the fundamental upheaval of the UK rail industry, the processes put in place have led to the underlying safety performance continuing to improve. The dreadful accidents at Southall, Ladbroke Grove and Hatfield do not lie outside the bounds that are predicted by long term statistical analysis. Last year, despite Ladbroke Grove, the total number of SPADs was the lowest ever recorded. Collisions and derailments continue to reduce and again are at the lowest level since records began. But expectations brought about by a hostile environment to Railway privatisation and a polarised media have moved even faster. Getting any good news out is virtually impossible, but bad news always makes the headlines. Since Ladbroke Grove Railtrack has actioned a huge number of improvements, and continues to do so. These include the acceleration of TPWS fitment, improvements at almost all Multi-SPAD signals, the introduction of the world's largest confidential incident reporting system (CIRAS), to name but a few. But good news on railways is not a story. Our reputation has gone and it will take years to rebuild. Only a total absence of accidents caused by factors within the control of the Railway Group will be good enough. That is why the target for accidental fatalities resulting from such causes has been set in this year's Railway Group Safety Plan at zero. We must have a complete intolerance of any failure resulting from factors directly in the control of the Railway companies. Nothing less will do. Success is essential.

Managers from those Railways which are earlier in the restructuring process take note. Do not believe privatisation is the key factor. Increasing expectations, separation from Government and the global nature of the media are much more important.

R I Muttram
31.10.2000

2000 LONDON

8 November - 10 November 2000
Forum Hotel, London, United Kingdom

Paper 0005

Dr. Debbie Lucas

Human Factors: Findings from Ladbroke Grove

Publisher
2000 International Rail Safety Conference

International Rail Safety Conference

Debbie Lucas

Head of Human Factors, Hazardous Installations Directorate

HSE, UK

<u>Human Factors: Findings from Ladbroke Grove</u>

Human Factors: Findings from Ladbroke Grove

Dr Deborah Lucas, HSE, UK

1 Introduction

On 5 October 1999 at 08.09 a Thames Train 3-car turbo class 165 diesel unit travelling from Paddington to Bedwyn, in Wiltshire collided with a Great Western High Speed Train travelling from Cheltenham Spa to Paddington. The accident took place 2 miles outside Paddington station, at Ladbroke Grove Junction. 31 people died and there were over 400 injured some critically.

Inspectors from HSE's HM Railway Inspectorate went to the site to investigate the causes of the crash. They reported that the immediate cause of the accident appeared to be the Thames Train passing a red signal (Signal Passed at Danger - SPAD) some 700 metres before the collision point. The initial report stated that *'the reasons why the 165 passed the red light are likely to be complex, and any action or omission on the part of the driver was only one such factor in a failure involving many contributory factors.'* (HSE, 1999a) The investigation considered human factors issues in some detail as did the Ladbroke Grove rail inquiry chaired by Lord Cullen.

2 Definition of human factors

The focus of this paper is solely on the human factors aspects of this train crash. Human factors is defined by HSE as: *'environmental, organisational and job factors and human and individual characteristics which influence behaviour at work in a way which can affect health and safety'* (HSE, 1999b). A simple way to view human factors is to think about three aspects: the job, the individual, and the organisation and how they impact on people's health and safety-related behaviour. A key message is that the interaction between these three aspects must be considered. For example, the interaction between the human and the hardware interface such as the driver and the signal. Human factors takes into account such aspects as the strengths and limits of the human cognitive system (memory, attention, vision, etc.) in the design of hardware. It also covers other important issues such as an individual's skills and experience, fatigue and alertness, and so on.

3 The human factors evidence at the Ladbroke Grove Rail Inquiry (LGRI)

In the first part of the LGRI (which covered the immediate causes of the crash) evidence was heard from a number of human factors experts Some of these experts had prior experience in the rail industry, others were academic psychologists who brought to the inquiry theories from cognitive psychology or expertise gained in the aviation or road transport sectors. The evidence given covered a number of questions:

(1) What aspects of the Ladbroke Grove rail crash appeared similar to situational factors reported for other signals passed at danger?
(2) What limitations of the human cognitive system need to be considered in relation to the sighting and viewing of trackside rail signals?

(3) What hypotheses might offer an explanation for why the driver of the Thames Train passed the signal (SN109) at red?

The report from the inquiry is not yet available so this paper will only touch on some of the evidence presented to give a flavour of the scope and depth. In particular the next section considers those situational factors which are reported in previous literature as being possible contributory factors to SPADs and which seemed pertinent to the Ladbroke Grove rail crash These were covered in my own statement to the inquiry This paper also gives some examples of the hypotheses which were proposed as possible explanations for the driver of the Thames Train to pass the signal at red. It must be stressed that these hypotheses are given only as examples of human factors evidence Readers should wait for Lord Cullen's report for conclusions as to the causes and contributing factors of this rail crash.

4 General situational factors

Some research into the causes of human error on the railways, including signals passed at danger, has been conducted although it is not all available in the public domain. However a review of such literature identified a number of situational factors which have been cited and which appeared to be applicable to the circumstances of the Ladbroke Grove rail crash. These are given below (the order does not reflect any priority).

4.1 Time of day

Studies have found that SPADs are higher for morning hours (0400 to 0900). Delays in responding to a vigilance device have been found during 0700 to 0800. The rail crash at Ladbroke Grove occurred shortly after 0800.

4.2 Shift pattern

Drivers on early shifts have been identified as more likely to have SPADs. Driver Hodder of the Thames train was on an early shift on the day of the accident. Studies have identified that drivers may be drowsy or fall asleep. However this seems to be more of a problem between midnight and 0800 i.e. during a night shift.

4.3 Time into shift

A number of studies have found that the incidence of SPADs is higher during the second to fourth hour of a shift. This is not related to the shift pattern or time of day. Driver Hodder booked on duty at 05.28 and the SPAD occurred during the third hour of his shift.

4.4 Route knowledge

No significant effect of experience on SPADs has been identified in the available literature. However drivers have claimed that poor route knowledge is a likely cause of SPADs on running lines. Driver Hodder had obtained his train driver competency certificate only 13 days prior to the accident. He had completed 9 shifts as the driver in charge before the day of the crash

Not knowing where a signal is sited has been identified as an error source. The signal SN109 that Driver Hodder passed at red is located near other signals. A confusion error between adjacent signals could be possible (however at the time of the SPAD all the signals were set to red).

4.5 Visibility of signal

Certain signals have repeated (multiple) SPADs. One study found that many such SPADs may have been due to reduced visibility as they were situated after a bend in the track. SN109 had been passed at red previously. It also had reduced visibility due to obstructions on approach by overhead wires and a bridge.

4.6 Other signal factors

SN109 is situated on a gantry with other signals. Drivers have reported having to 'count across' the gantry to identify the correct signal. This could lead to confusion between two signals. However at the time Driver Hodder saw SN109 all signals on the gantry were set to red.

4 7 Speed of train

SN109 has a number of visual features in addition to the coloured aspect lights. The visual complexity of a signal could lead to a high demand on the information processing capacity of a driver. This might lead to an overload situation and hence to errors particularly when there is limited time to view the signal. The impact of such features of a signal on SPAD rates has not been studied. However the literature does identify an increased SPAD rate after resignalling.

4.8 Incorrect anticipation of signal aspect

Researchers have identified that one reason for a SPAD is a driver incorrectly anticipating that a signal aspect would be showing a proceed aspect. This is likely to be on the basis of their past experience with that signal. Driver Hodder had not previously been stopped at this signal.

4.9 Distraction and preoccupation

Many studies identify that SPADs may be attributed to distraction by activities or objects outside the cab. A speed board was present near signal SN109 and there were signals for adjacent lines nearby. These might have been a source of distraction A driver being inattentive or preoccupied has been identified as another common reason for a SPAD.

4.10 Summary

On the basis of this review I noted that a number of factors which have been identified as causes or correlations of SPADs previously appear to be present in the Ladbroke Grove rail crash. In my evidence I stated that 'this regrettable conjunction of so many previously identified SPAD risk factors would have put Driver Hodder at an increased risk of passing a signal at danger'. (Lucas, 2000).

I also pointed out that there have been limited findings linking organisational and management aspects of SPADs. In particular, the following aspects have been linked to SPADs: staff attitudes, the reliability, quality and useability of frequently operated equipment, standards of maintenance of signals, compliance with signal siting policy and practice and pressures to keep to the timetable.

5 Examples of hypotheses

During the evidence heard during part 1 of the Ladbroke Grove rail inquiry a number of possible hypotheses were put forward to try to explain why the driver might have passed the signal at red. Evidence from equipment on board the train indicated that the driver had slowed down some distance before the signal but then speeded up as though he believed that he had seen a 'proceed' (green) aspect. The hypotheses therefore looked at why he might have had such a belief. One particularly important feature to note is that the experts were clearly looking at how the design of the signalling system may have interacted with the human information processing system to lead to this erroneous belief. Some examples of the hypotheses are outlined below. (Note that these have been simplified for the purposes of this paper.)

5.1 Visual swamping of the signal.
The effects of bright sunlight on the signal may have led to the driver perceiving a yellow aspect rather than the red.

5.2 Non-parallel signalling
The pattern of signals in the 2 miles of track outside Paddington station contain some locations where not all tracks are signalled The location of signals near SN109 is such that it might be possible for an inexperienced driver to fail to appreciate that there is a signal for the route that he/she is on.

5 3 Anticipation of signal aspect
Since not all the signals on the gantry come into view at the same time there may be a tendency to prejudge the aspect of those which appear later. Prior experience at a signal of receiving a 'green' aspect could bias such prejudgement.

5.4 The meaning of the automatic warning system (AWS) horn
The AWS horn is used to denote a cautionary or stop signal aspect. At certain locations it is also used to indicate a speed restriction. As there is a speed board near to SN109 a confusion might be possible.

5.5 The use of the driver reminder appliance (DRA)
DRA is a manually set device in the cab. Drivers use it to remind themselves when they are stationary that a signal has been set to 'red'. If they try to take power when DRA is set they cannot. However if DRA is used at cautionary aspects then there is the possibility that a driver may come to rely on it rather than checking for the red aspect. There would be increased risk of a SPAD if a driver who was using DRA in this way then forgot to set DRA at a cautionary aspect.

5 6 Visual overload
The nature of the human visual system means that a driver's vision attention switches between objects in the cab, and those outside on the line. The signal may be only one of these sources. A signal can be a complex information source if it is not easy to identify which signal applies to the route or if the signal has a number of features. Depending on the number of attention sources, the time to focus on each one may be very short. In some cases a signal may not be viewed within the signal sighting time.

5.7 Summary

The range of hypotheses proposed are indicative of the many facets of human factors that were issues in the Ladbroke Grove rail inquiry. The report of the inquiry will provide conclusions about why the crash happened. This paper has merely stated briefly some of the hypotheses which were put in evidence to the inquiry It offers no preference over which of these may be more probable than others.

6 What have we learnt about human factors?

Part 1 of the Ladbroke Grove rail inquiry was followed by a joint inquiry into train protection systems presided over by both Lord Cullen and Professor Uff In the course of this joint inquiry the human factors experts from the Ladbroke Grove (who were also experts for the Southall rail inquiry) were asked to prepare a joint report. The aim was to set out some general principles on human factors. I undertook to pull this document together with inputs from Professor Neville Moray, University of Surrey , Professor John Groeger, University of Surrey, Professor Helen Muir, University of Cranfield, and Ms Emma Lowe, Railtrack Safety and Standards Directorate. The 'consensus principles' which were developed are given in full below. In my view they are an excellent summary of the key human factors issues that came out of both the Southall and Ladbroke Grove rail crashes. The principles apply to significant human factors issues which are relevant to reducing the number of signals passed at danger.

7 Human factors consensus principles

7.1 Design issues

HF1 Human factors aspects of train driving cover not only the characteristics of the driver (e g. route knowledge, alertness, etc.) and the equipment (e g signalling, train controls and instruments, etc.), but also the interface between the driver and the equipment. Full evaluation of this human-machine combination is vital for the reduction of opportunities for human failures. This analysis should be done by incorporating knowledge about human information processing, human reliability, and good ergonomic principles into the design and evaluation process. It is a serious weakness if well established principles of ergonomics are ignored.

HF2 When implementing a fully (or a partially) automatic protection system such as TPWS or ATP it is essential that its evaluation should include

(i) whether the operators (signallers, drivers) fully understand how the system works

(ii) whether they understand its limitations (e.g. in terms of speed, operating conditions)

(iii) whether a study has been made of its failure modes and how the operator will respond when the system fails. Sooner or later all hardware and electronic systems fail. Operators must be taught what will happen when the system fails, what are the symptoms that show it has failed or is failing, and what actions they must take.

HF3 The design process for new equipment e g. cabs, interfaces of equipment in control rooms, should consider human factors issues explicitly. Building the needs of the users of systems into design prevent human errors from arising This requires early incorporation of human factors thinking and involvement of future users of the equipment in the design process.

7 2 Signal sighting

HF4 Signal sighting principles and practice and signalling design must consider the limitations of human physiology and anatomy in particular:
(i) the reliability of colour discrimination in the periphery of the retina
(ii) the dynamics of visual attention especially where there are several objects in a visual field and
(iii) the impact of temporary interruptions of previews of the signal caused by changes of visual attention (e.g. between track, signal and in-cab instruments), signal obscuration, and changes in signal position on approach (e g. when approaching a signal on a curve)

HF5 Complex signal and track layouts impose higher demands on drivers' route knowledge and attention. The designers of signals and signal sighting arrangements must recognise that more complex designs and minimal compliance with such standards as currently exist impose additional demands on drivers and lead to more opportunities for human failures. Presenting information in a consistent and straightforward manner, avoiding anomalies, and reducing other visual distractors at signals should be the normal good practice for all signals. It should always be possible to identify a signal directly and uniquely. There should be a requirement for an ergonomic assessment of the 'driveability' of a route for new signalling layouts. This is particularly necessary when such layouts are complex. The process for derogations or authority for non-compliance with such standards should consider carefully such human factors issues.

7.3 Warning devices

HF6 Warning devices should be designed according to known 'best practice' ergonomic principles. This would ensure that it is clear to drivers what the warnings are signifying and what action should be taken The inability of AWS to distinguish between cautionary and danger aspects is an ergonomic design problem

HF7 The use of existing warning devices to warn of other situations must be considered very carefully (e.g. using AWS to warn of other non-signal situations such as speed restrictions) since this may reduce its effectiveness as a primary warning to the driver of the need to stop the train. It is also important to consider the impact of other systems on existing warning devices, for example, on the introduction of TPWS or more advanced systems Warning devices which are fitted in cabs to alert drivers to signals can give rise to a level of dependence on the device. Such dependence, and the risks associated when it is not provided, should be considered for existing systems and during the design and risk assessments of new warning devices.

7.4 Training and route knowledge

HF8 A driver's knowledge of a number of 'routes' is a key element in the prevention of signal reading problems particularly for complex layouts. Human memory has known limitations. These limits need to be recognised and, where possible, other means of support given to drivers to reduce high demands on memory The training and assessment of such 'route knowledge' would benefit from increased rigour, interactive, computer-based instruction and assessment rather than relying on verbal reports for the assessment of competence.

HF9 Drivers will rarely experience certain abnormal or degraded situations (e.g. driving with warning devices isolated) or emergencies (e.g. detraining passengers). Regularly encountering such situations in a simulated environment will assist them in dealing more effectively with any real-life occurrences. Simulators are becoming more widely used across many industries for initial and refresher training and for assessment of some elements of competence. Their use in the rail sector would be beneficial. The selection of the appropriate fidelity of simulation for such training should be based on a suitable analysis of driver training and assessment needs.

7.5 Alertness and fatigue

HF10 Reduced alertness due to the effects of fatigue or the repetitive nature of a task is one of a number of influences on the human performance of all safety critical staff Good practice guidelines on shiftwork and the timing of breaks within shifts exist and should be used more widely within the rail industry.

7 6 Developing human factors capability in the rail industry

HF11 Risk assessments should continue to consider those human failures which may initiate incidents or mitigate the consequences of accidents. Safety cases should consider fully the risks from human failures and their associated control measures. The further development, and use of, existing human reliability methods within the rail industry would be advantageous. The numbers of staff in the rail sector with sufficient knowledge of human factors would need to be increased for such assessments.

HF12 Signal sighting committees should be able to call on expert human factors assistance when complex layouts and signalling situations are in question. Investigators of incidents should also have access to suitably trained and experienced specialists.

7.7 Incident investigation

HF13 The investigation of incidents of signals passed at danger should be informed by human factors theories cast in appropriate investigatory tools. The causal analysis of such incidents and accidents should consider possible combinations of human factors relating to individual and system/equipment aspects and to the interface between individuals and systems. The information provided by on train monitoring recorders should routinely be investigated following a SPAD. Statistical analysis of data from such accidents and incidents should build on research already published including that on the influence of organisational and managerial on incidents. Suitable caution should be exercised when the attributed cause of a serious SPAD is solely dependent on the recollection of those involved. Information reported by traumatised individuals can be unreliable and should be supported by other information sources

7.8 Increasing the awareness of human factors

HF14 There is an awareness of the potential threat to safety caused by human factors In order to understand the issues in more detail it is advised that information about the causes of error, the influence of different types of stress and workload on performance and the potential for fatigue, health, communication, etc. to limit performance is included in the training of safety critical staff and their managers Such a requirement for awareness training is already in operation for pilots in the aviation industry

7.9 Confidential reporting

HF15 The confidential reporting of safety related incidents provides an important additional source of information to learn from. Such systems of reporting also maintain a certain level of safety awareness among staff.

7.10 Management of drivers

HF16 There are also issues around the management of drivers, particularly those who have been identified as 'at risk'. The use of the ontrain monitoring systems (OTMR) to proactively evaluate the driving styles of such drivers would be a useful information source. The management of new drivers, especially those who have been recruited from outside the rail sector, is also a key area Evaluation of the suitability of training and assessment regimes for this category of driver is recommended.

8 What would be the benefits of applying such principles?

Following the list of consensus principles the human factors experts concluded that:

'In proposing these principles we are fully aware that they cannot eliminate all signals passed at danger and that a technical solution which would prevent those human errors which lead to serious consequences is needed. The design of any such technical solutions needs to consider human factors in order to avoid introducing additional risks However, applying the above human factors principles should reduce the variability in the occurrence of SPADs between signals and between drivers and should therefore reduce SPADs overall. We are not able to quantify the likely extent of this reduction however we anticipate that paying attention to these key human factors issues would prevent more of those SPADs on running lines which are currently stated to be caused by 'inattention', 'misread signal' and particularly 'disregard signal'. The latter category include many SPADs which have had serious consequences.' (Joint inquiry, Human factors report)

References

HSE (1999a) Train accident at Ladbroke Grove Junction, 5 October 1999. Third HSE interim report
HSE (1999b) Reducing error and influencing behaviour HSG48. HSE Books. ISBN 0 7176 2452 8
Lucas, D A (2000) Human factors statement presented to Ladbroke Grove Rail Inquiry.
Joint inquiry (2000) Report of human factors experts.

International Rail Safety Conference

2000 LONDON

8 November - 10 November 2000
Forum Hotel, London, United Kingdom

Paper 0006

Mrs Faye Ackermans

Incorporating a Human Factors Approach to Investigating Rail Incidents

Publisher
2000 International Rail Safety Conference

International Rail Safety Conference

Faye Ackermans

General Manager, Safety & Regulation

CPR, Canada

Incorporating a Human Factors Approach to Investigating Rail Incidents

INCORPORATING A HUMAN FACTORS APPROACH TO INVESTIGATING RAIL ACCIDENTS AT CANADIAN PACIFIC RAILWAY

Presented to: International Railway Safety Conference
November 8-10, 2000
London, England UK

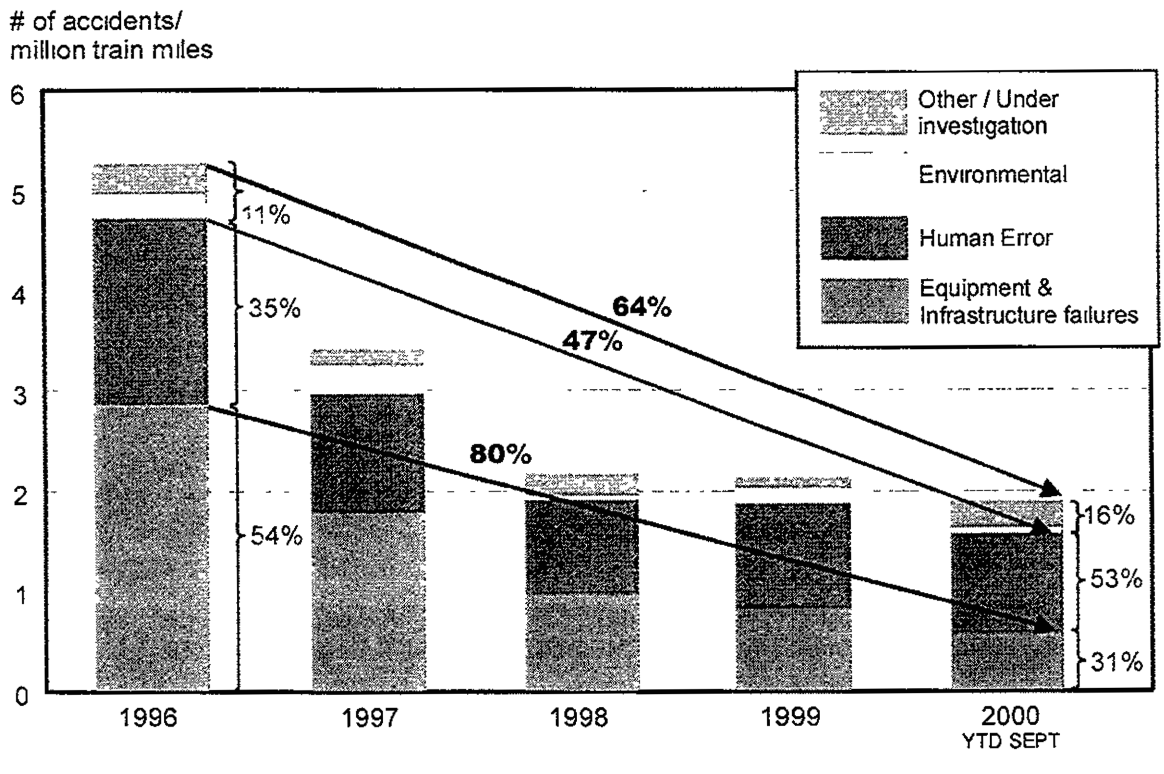
By: Faye Ackermans
General Manager, Safety & Regulatory Affairs
Canadian Pacific Railway
Canada

CANADIAN
PACIFIC
RAILWAY

All safety professionals know that the human element in any process or system is a guaranteed source of errors. Yet many of the procedures in rail operations rely heavily on knowledgeable and experienced people doing their jobs correctly. To guard against human errors, railroads have built up extensive rules and procedures, employee selection processes, training programs, on-the-job supervision and so on. We also have some automated systems that either aid people in avoiding mistakes or catch the mistakes people make, and we are always looking for ways to improve our safety defenses. Minimizing the errors people make is key to making further improvements to safety at Canadian Pacific Railway.

At Canadian Pacific Railway, safety performance of train operations is measured using several metrics, the key ones being cardinal rule violations, crossing and trespasser accidents, non-accident releases of dangerous goods, and train accidents. Train accidents are subdivided into two categories; FRA[1] reportable which are tracked by primary functional responsibility and non-FRA reportable. Over the period from 1996 to the

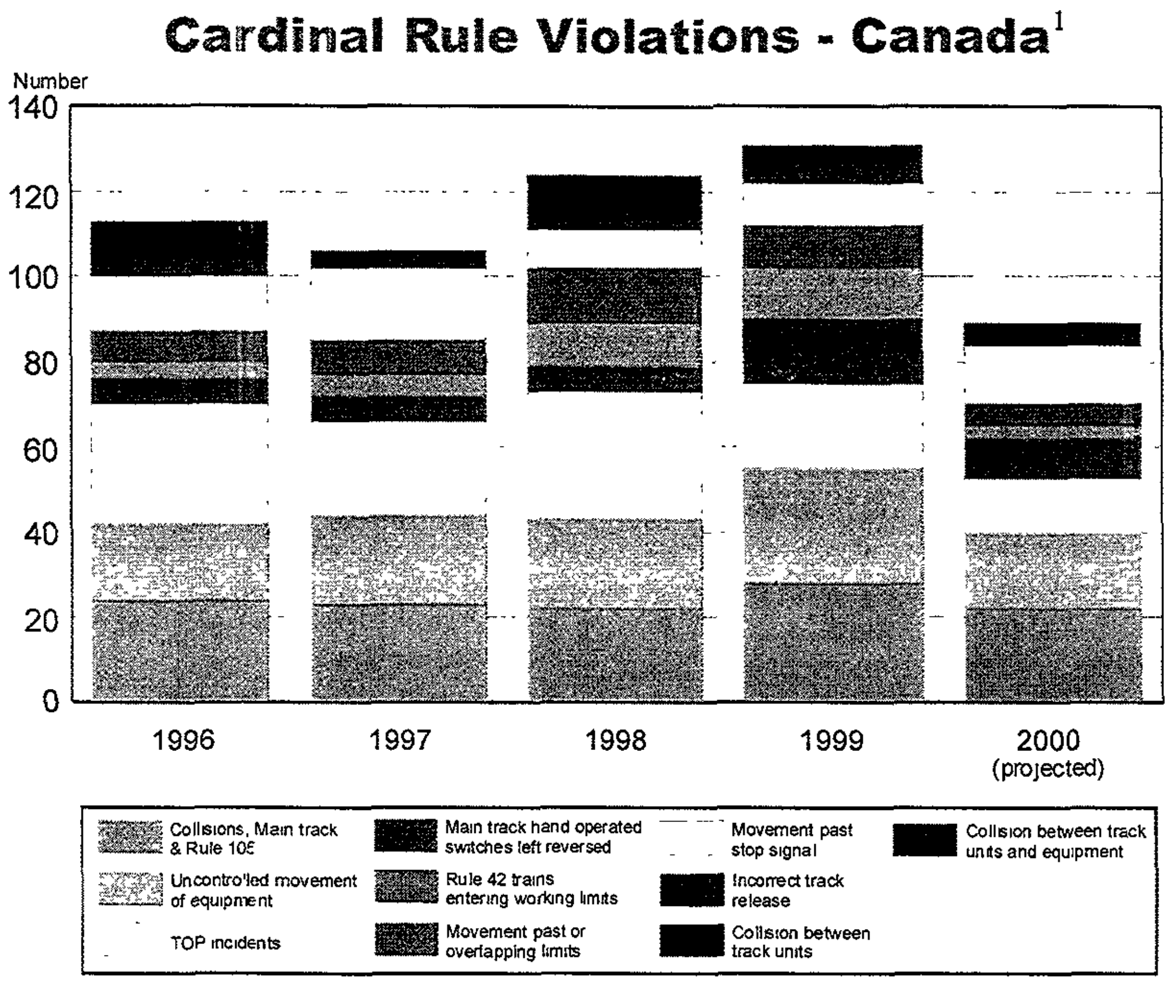
Frequency of FRA Reportable Accidents - CPR



[1] U.S. Federal Railroad Administration criteria are used to track accidents in order to allow comparison with U.S. railroads. Accidents are defined as those incidences where cost of damage to infrastructure or equipment exceeded $6,600 U.S. for 1999 and 2000. The dollar threshold was slightly lower in earlier years.

present, the frequency of FRA reportable train accidents classified as primarily due to a technical failure (infrastructure or equipment failure) have declined by 80%; those with human error being the primary direct cause have declined by 47%. While both numbers are impressive, we are now in a situation where further improvement has to come from reductions in human errors. To date in 2000, 53% of all FRA reportable train accidents and the vast majority of all non-FRA reportable train accidents, are caused by human error. In 1996, only 35% of our FRA reportable accidents were human error based

Another category of errors, operating rule violations, which are extremely serious mistakes that can lead directly to on-track accidents, have not improved since 1996. In fact, the number of cardinal rule violations (CRVs) in Canada in 1999 was greater than in 1996.



[1] CRVs are tracked for all CPR's operations now, but we do not have historical information for our U.S . properties. Thus, only the trend for Canadian violations is shown.

In 2000, we may be seeing the first year of an improvement, actual year-to-date at the end of August, when projected to year-end, shows a decline of 30% from 1999 actual.

We began in 1996 to look for alternative ways to diagnose and mitigate the errors that people make. While CPR had been involved in some pioneering work on managing fatigue of train crews (the CANALERT project), we have extended our fatigue management efforts to other employees, including mechanical workers in shops, track maintenance of way employees and signals and communications technicians. We also examined the cockpit resource management programs of two large US airlines, and created our own "crew resource management" training program. This program was piloted in 1999, and is now being rolled out to over 6,000 employees who operate trains on our railway. It is a two day program that addresses five key areas of the human side of crew performance, namely, human factors, situational awareness, communications, team work and technical proficiency. These two topics, fatigue and crew resource management, deserve a presentation in their own right and will not be covered any further here.

We have also made some progress in using a "human factors" approach to investigating and more thoroughly understanding why our people make the mistakes they do. The rest of this paper deals with using a human factors approach to investigate accidents and incidents at CPR.

Track Occupancy Permit Violations

Our first experience came in 1997, when we contracted with a consultant to examine a group of track occupancy permit[1] violations where track maintenance workers were left unprotected on the track. While the experience overall was beneficial and helped us to make some changes to the procedures, documents and system used by rail traffic controllers and track foreman to safely allow track workers access to the tracks, we were not satisfied with the perceived benefit given the amount of time, effort and cost involved. It did confirm that the organization could benefit from a human factors approach. After some further deliberations, we hired an individual with "human factors" expertise but no rail experience. She joined our train accident prevention team on September 30 1998.

---

[1] Track Occupancy Permit (TOP) is a process whereby a Rail Traffic Controller gives a track maintenance worker ownership of the track. It involves keeping paper documents in the field and computer documents in the office and a process for clearly communicating and confirming with each other what the limits are, and which other workers are protected.

Collision at Kemnay, Mileage 9.6 Broadview Subdivision

Three weeks later, on October 20, 1998, an experienced train crew operating a 5,802 ton train with two locomotives and 43 loaded cars of potash ran into the back of a standing 15,174 ton grain train, consisting of six locomotives and 118 loaded cars, at 16.4 mph. The accident occurred on single track. The standing grain train was waiting on the main line for a train travelling in the opposite direction to enter a siding, after which, both main line trains would have been given signal indication to proceed. The crew that made the error were tired, a few miles from home, and on their second tour of duty for the day. The accident occurred at 00:56. Damage to equipment and costs to clear the site amounted to $260,000. Fortunately, the crew suffered no injuries in the initial collision, nor were they trapped in the grain which subsequently filled the cab of their locomotive. We convinced the vice-president and general manager of Operations that this accident presented an excellent opportunity to use a new investigative approach to explore the mistakes made by the train crew. Further, this new approach would uncover more detailed information than the normal disciplinary-centered investigation. A local agreement with the Union was prepared which waived discipline for this one occurrence. At the time, it was felt that such an agreement was necessary in order to have an in-depth, truthful investigation, with no fault and no blame.

The first draft of the investigation report raised a storm of controversy within our Operations senior staff. The report was unlike any our operating managers had seen before. Labour Relations was equally unhappy with the content and format. Several meetings were required to review the findings. Some compromises were made until we had a report that was "acceptable". In this case, "acceptable" meant a report that was disliked by most Operations and Labour Relations staff but which my staff felt was somewhat watered down. In other words, no-one was happy with it. In fact, some of the findings, recommendations and safety actions were removed from the official report and tracked separately. The official report contains discussion and recommendations on topics such as fatigue, train line-ups and booking rest; teamwork and communication in the cab between the conductor and locomotive engineer; training versus in-depth understanding of a particular rule; interaction between the rail traffic controller and the crew; general compliance with operating rules; the assumptions that were made by the crew members and their impact on their situational awareness; and visibility of the rear end markers on the grain train. Luckily, the people directly involved in the investigation at the local level, including the general manager, felt the "human factors" approach had uncovered more useful information and more useful corrective actions than would have been the case in a typical disciplinary oriented investigation. We had gained some support. In retrospect, what was probably more important -- we got their attention.

Train Accidents in Northern Alberta

The next set of investigations was a planned project that commenced in January 1999. For 18 months, until June 2000, every train accident involving an error by a crew member resulting in any amount of damage, any cardinal rule violation and any reported "near accidents" occurring in Northern Alberta, was examined from a human factors approach. This geographic location included 192 operating employees with home locations in two cities, Red Deer and Edmonton. It was chosen because of the relatively high frequency of incidents compared to other locations and its close proximity to headquarters staff. The work included yard and terminal switching, main line trains, belt pack (remote) operations, local assignments and way freights.

The project involved several levels of management and both union and management participants from two safety and health committees. Discipline was waived in hopes of promoting open and honest flow of information including voluntary disclosure of information surrounding issues such as culture and crew interaction. Rather than a formal hearing with union representation that is the norm in a typical discipline oriented investigation, a less formal interview was conducted. Included was the development of a detailed flow chart of events leading up to an incident. After the flow chart was produced, possible contributing factors were identified. The information was then analyzed using human factors principles to determine root causes and high level contributing factors. Follow-up interviews, on-the-job observations and an employee survey were all used to gather more information.

In all, 64 separate occurrences were assessed, involving 152 or 79% of the employees. The four most common occurrences were running through switches (20), shoving over derails or stop blocks (15), sideswiping equipment (10) and cardinal rule violations (8).

Errors were classified into three types. Slips and lapses occurred 20% of the time; mistakes occurred 56% of the time; and deliberate violations occurred 23% of the time.

The slips/lapses category included instances where employee attention was distracted or where there was memory failure. The "mistake" category included errors where an employee believed he was performing his duties properly with an acceptable method, but in fact, there was a short cut or a deviation from rules and procedures. (In such cases, an employee felt justified or had been doing it that way for so long, it had become the accepted practice). Many of these were rule violations, but were not recognized by employees as violations. The mistake category was also used for sloppy work habits, poor communication, lack of teamwork, operating based on assumptions and errors due to inexperience or lack of knowledge. The deliberate violations category was used to classify those instances where an employee willfully violated rules and procedures.

An analysis of the factors which contributed to the errors yielded the following. Note, that several factors may be present at a single occurrence.

Table I:

Summary of High Level Contributing Factors in Accidents As of June 30, 2000

High Level Contributing Factor	Train Accidents %	Number
Lack Of Teamwork	52%	33
Operating Based Upon Assumptions	48%	31
Technical/ Operating Errors; Lack Of Knowledge	47%	30
Attention Not on Task at Hand	47%	30
Rule Violations	39%	25
Lack Of / Vague Communications	31%	20
Poor Situational Awareness	27%	17
Equipment and Procedure Issues (Switch Targets, Labeling, Etc.)	19%	12
Poor Job Briefing	19%	12
Shortcuts, Sloppy Work Habits, Perception Of Safety Due To Experience, Low Volume, Etc	19%	12
Lack Of Guidance For Junior Employee/ New Situation	17%	11
Individual Distracted Due To Annoyance/ Rushing, Frustration, etc.	16%	10
Interpersonal Conflict Between Crew Members	5%	3
Total Incidents investigated		64

While attempts were made to relate the 64 occurrences to many variables, because the sample size was relatively small, only two factors showed some interesting relationships. The first factor was time into the shift. Twenty-five percent of incidents occurred between the 4th and 5th hour. We believe this may have been due to rushing before and after the mid-shift meal break. The second category was experience; 47% of the employees involved in incidents had five years or less experience on their job, irrespective of their age or total years of service with the company. Factors which appeared to have little relationship with the incidents were the number of demerits acquired in the past three years, number or type of proficiency tests conducted on employees, time of day, day of the week, month, temperature and weather conditions.

Was the project a success? In some ways it was, and in other ways it was not:

1. The number and frequency of incidents over the study period showed slight improvement, but the improvement was similar to that occurring elsewhere at the same time. Therefore, the project appeared to have no influence over the total performance of the operating crews working in this geographic location.
2. Some of the corrective actions that were undertaken would likely not have been identified in our usual incident investigation process. For example, in one run through switch incident involving inattention, the switch target was changed from a yellow to a combined yellow and green, to help draw attention to the switch.
3. A number of procedural changes were made, including use of a more structured job briefing checklist to improve crew communication, better dissemination of the root causes of the incidents to all employees to promote awareness and more focused proficiency testing after an occurrence to ensure employees were not continuing to take the same kinds of short cuts. These have been progressively implemented elsewhere.
4. In retrospect, total removal of discipline likely contributed to an uncaring attitude in some people. Two employees were involved in 5 separate occurrences and one other was involved in four. The absence of discipline seemed to spawn an attitude where some employees did not feel accountable for their actions.
5. In contrast a couple of other employees showed marked improvement in attitude and performance.
6. Some employees did not respect the new approach and did not feel it had any meaning as there were no consequences (i.e., no discipline).
7. Local management staff were really committed to making this work and completed all of the tasks required of them, while some union representatives and some employees were reluctant to participate either in the investigations or the corrective actions.
8. The issues identified during the project were worked into revised scenario based training for operating staff that operate in yards. This training, which is system-wide, has been well received.

An employee survey was conducted at the end of the 18 month period. One hundred and thirty-eight questionnaires were handed to individuals by S&H committee representatives, and 77 were returned for a response rate of 56%. Some of the findings included:

Employees were aware of and accepted the main causes of the accidents occurring in the area:

1. They were aware of the types of changes in work behaviours that are required to address the problems;
2. Some said they have started to engage in the required behaviours;

3. Many expressed reluctance to accept responsibility for their role in reducing accidents;
4. Many felt that violating rules and taking short cuts in order to get the job done, was still acceptable.

Bottom line: ***Culture change in this group of employees is going to take hard work and time.***

Other investigations

Also commencing early in 1999, mistakes made by rail traffic controllers in the Calgary Network Management Centre over a six month period were reviewed using a human factors approach. The process involved analyzing incidents to determine what types of errors were leading to cardinal rule violations and recommending corrective actions which would be effective in addressing them. Upon completion of the review, a committee made up of mangers and employees was developed to address some of the problem areas highlighted. This included issues such as the layout of forms, the order in which information was presented on the dispatch screens and the way overlapping information was dealt with by RTCs on adjoining subdivisions. A database to collect and monitor data regarding factors related to human errors (such as hours into shift, experience on the subdivision, etc.) was set up. Data is now being entered for all incidents which occur. This review was also utilized by the NMC when they set up a pilot project to introduce a more positive oriented based discipline system.

An investigation into a fatal employee accident was conducted. This accident occurred on October 5, 1999 when a maintenance-of-way worker threw a piece of hot slag from a thermite weld into nearby water. The slag reacted by exploding and fragments struck the employee in the forehead. Fellow workers did not see him throw the slag into the water, nor did he indicate to anyone what he was about to do. The report stemming from this investigation has resulted in some extremely controversial discussions both internally with management and externally with the unions. It has been a year since this employee died, and the report is not completed yet.

Developing New Accident Investigation Tools

By the beginning of 2000, we felt we were ready to move some of the techniques we had learned into the hands of operating managers responsible for day-to-day accident investigations. A project team was formed, including representation from the unions, Labour Relations and the functional departments within Operations, to create a comprehensive set of human factors "tools" and training to be used by all managers responsible for investigating accidents, incidents, cardinal rule violations and "near" accidents.

The new tools and process were designed to bring all investigation processes and tools into one standardized investigation manual; to compliment the current structure and types of investigations; and to provide a set of skills and tools for both novice and experienced investigators.

They were not designed to change the current structure of investigations and statement taking; to change/affect the current discipline system; to cause a significant increase in work or time; or to conflict with previous processes or training.

What are the tools?

- High level flow chart outlining the steps to follow for initial data collection
- Flow charts for each investigation level outlining steps for the formal investigation and generation of corrective actions
- Decision charts to determine level of investigation required
- Data Collection Guide for train accidents, personal injuries and human error issues.
- Chart to determine the types of human errors (the Basic Error Analysis Form)
- Chart to track the issues identified during the data gathering and formal investigation
- Corrective action guide for developing effective interventions
- One investigation manual which will contain all of the tools and incorporate information currently in the train accident cause finding manual as well as other manuals and tools in use.

The appendix contains examples of some of the tools. Included are the Basic Error Analysis Form, examples of the "human factors" data collection sheets that form part of the Data Collection Guide and samples from the Corrective Actions Guide.

We now have final agreement internally on the content of the proposed tools. Training material and final forms are in development and the tools will be introduced in the first quarter 2001 on a pilot basis. We anticipate commencing roll out of the final product across our system by mid year 2001.

Suggested corrective actions for human factors have been grouped into four categories:

- standardization of investigations across CPR
- improvement in the amount and type of data collected
- improved ability to determine root causes
- more effective corrective actions

Summary of CPR experience to-date using a human factors approach to investigating occurrences

We have been actively engaged in using a more human-centered approach to accident investigation in limited circumstances for two years. Recently we sat back and took a look at our successes and failures, and concluded that:

a) Although there has been an openness to trying the process, acceptance of results has varied dramatically. This seems to have been related more to the individual in charge than the function or incident being investigated.
b) When people have decided to use the approach, they often did so thinking that it would "prove" their point of view. Management staff expected it to mainly show employee errors; union officials expected it to demonstrate all fault lay with the company. It has generally been the case that the root causes were distributed across both, and both sides have concluded they were tricked into a process that made them look bad.
c) In some cases, managers, employees and union officers have interpreted the results as a personal attack and they have been very defensive.
d) Results have tended to be better accepted if the person requesting a human factors approach felt they were not in control of some of the areas which were found to be causal, for example, work load due to staff cuts that were beyond the immediate supervisor's control.
e) Because is was first introduced with no discipline, it has been seen as a "cop-out" by those managers and employees who believe in a traditional approach to discipline.
f) Specific pockets of employees and managers have been very open to examining human factors issues and addressing them.
g) There still exists a great deal of misinformation and misunderstanding about the approach.

In conclusion, the culture at CPR is not yet very accepting of a Human Factors approach to accident investigation. However, specific groups are supportive, and are actively using the approach. We believe incorporating the human factors tools into our usual investigative processes without altering our approach to discipline, will alleviate many of the concerns that have been expressed about employee accountability. In any case, we believe discipline is required in circumstances where willful violations to rules and policies occur. We are optimistic that over time, successes in some groups of the company combined with more general understanding of how to use this approach, will lead to more effective investigations and corrective actions. Along the journey, we expect to see a profound shift in culture within Canadian Pacific Railway. These changes are absolutely necessary for us to accomplish continued reductions in train accident rates.

APPENDIX

Basic Error Analysis Form

Contributing Factor:

____

____

____

❑ Unsafe Act

- ❑ **Unintentional**
  - ❑ Attention (slip)
    - ❑ Distracted
    - ❑ Attention not on task
  - ❑ Memory (lapse)
- ❑ **Intentional**
  - ❑Mistake
    - ❑ Misapplied Rule
    - ❑ Didn't know rule
  - ❑Violation
    - ❑ Short Cut / Adaptation
    - ❑ Unusual or Extreme Circumstance

❑ Unsafe Condition

- ❑ Known Previously
  - ❑ Interventions in Place: __________________________________

    ____

    ____

    ____
- ❑ Unknown Previously

Precursors / Contributors:

- ❑ Health / Nutrition
- ❑ Stress
- ❑ Fatigue
- ❑ Alcohol / Drugs
- ❑ Attention
- ❑ Memory
- ❑ Workload
- ❑ Expectations / Assumptions
- ❑ Decision Making
- ❑ Experience / Knowledge / Training
- ❑ Personal Factors
- ❑ Physical Limitations
- ❑ Communication / Teamwork
- ❑ Crew Interaction
- ❑ Interaction With Other Crews / Functions
- ❑ Organizational Factors
- ❑ Immediate Supervision
- ❑ Associations and Unions
- ❑ Written Information / Documentation
- ❑ Rules and SOPs
- ❑ Regulatory Requirements
- ❑ Immediate Environment
- ❑ Workspace and Comfort
- ❑ Physical Space and Arrangement

The Data Collection Guide

Example of data collection questions

⇒ "Attention"

Attention is a limited resource. Stress and inexperience can lead to narrowing of attention. Experience can lead to complacency and not paying attention to the task at hand. Distractions and interruptions can take attention away from important factors and cause steps in a sequence to be omitted.

Was attention to the task or important factors associated with the task a factor in the accident / incident? If no, proceed to *Memory*.

Questions	Yes	No
Were there any distractions before or at the time of the accident / incident?		
Is this task performed infrequently?		
Was the person thinking about something other than the task at hand immediately prior to the accident / incident?		
Was the person thinking about something other than the task at hand at the time of the accident / incident (e.g. Upcoming moves, unexpected complications, problem solving, trainee?).		
Did more than 5 minutes pass between when the action was planned and when it was executed?		
Were persons feeling stressed or rushed at the time?		
Was this task performed differently than it is normally performed?		
	If there were "Yes's" in this column, this should be investigated further as a cause factor.	**If all of the rows indicated "No's", this may not be a cause factor.**

The Data Collection Guide

Example of data collection questions

⇒ "Communication"

Miscommunication can lead to misunderstandings and misinterpretations. Communications include all individuals around at the time and can be verbal or non-verbal. Non-verbal communication can be intended (e.g. hand signals) or unintentional such as defensive body language.

Was communication a factor in the accident / incident? If no, proceed to *Co-worker Interaction.*

Questions	Yes	No
Were improper radio procedures / visual signals used?		
Were ambiguous terms / saying used?		
Was the communication unclear (e.g. was there radio interference or static)?		
If communication was unclear did the person neglect to seek clarification?		
Was the environment noisy or otherwise prohibitive of clear communication?		
Was a repeat back used?		
Were there any language barriers?		
Was any non-verbal communication misunderstood?		
Did any non-verbal communication create any negative emotions or pressure?		
Was there a disagreement regarding what the manner in which the task should be carried out?		
Was there a disagreement regarding how to proceed?		
	If there were "Yes's" in this column, this should be investigated further as a cause factor.	**If all of the rows indicated "No's", this may not be a cause factor.**

The Data Collection Guide

Example of data collection questions

⇒ **"Supervision"**

Supervision factors are concerned with the interaction between the employees and the front line management they deal with on a daily basis. These interactions can send strong messages regarding what is expected of employees and what is or is not acceptable.

Was supervision a factor in the accident / incident? If no, proceed to *Associations and Unions.*

Questions	Yes	No
Did the supervisor(s) know previously about any unsafe acts that may have contributed to this accident / incident? (e.g. did the supervisor know that the proper radio procedures were not being used?)		
Does the supervisor (s) know and understand all pertinent rules and their applications?		
Is the supervisor(s) lax in strictly enforcing all operating rules?		
Is the supervisor(s) lax in strictly enforcing all safety rules?		
How often are proficiency tests conducted? Specifically, how often had a proficiency test relating to the rule infraction in question been carried out in the previous year?		
Are the supervisors occasionally found not complying with all safety and operating rules?		
Does the person feel they cannot approach their supervisor(s)?		
If an unsafe act was involved, is this the normal / common way of doing it?		
Had a similar accident happened in the past and no corrective actions were taken?		
Are employees rewarded for unsafe behavior and punished for rule compliance (e.g. Does rushing and taking short cuts get you an early quit?		
Does the person's manager challenge him/her for taking longer to ensure all rules and procedures are followed?		
	If there were "Yes's" in this column, this should be investigated further as a cause factor.	**If all of the rows indicated "No's", this may not be a cause factor.**

The Data Collection Guide

Example of data collection questions

⇒ "Written Information"

Written information includes manuals, checklists, log books, bulletins or any other written documentation. It also includes software programs if the job involves the use of computers. Poorly designed documentation can lead to increased response time, can create confusion, can increase the risk of items being missed, can lead to shortcuts and can cause unnecessary distractions. In this category we are concerned with the manuals and documentation that supports the rules and procedures.

Was written information a factor in the accident / incident? If no, proceed to *Rules and Standard Operating Procedures.*

Questions	Yes	No
Was the required documentation difficult to access?		
Did the person misunderstand the expectations?		
Was there a lack of training when revisions or changes were made?		
Did the person misunderstand where to look for the information?		
Did the person misunderstand the proper use of paperwork (e.g. TOP books, RTC planning sheets)?		
Were the written instructions ambiguous or open to interpretation?		
Was training inconsistent with manuals?		
Were employees aware of revisions or exceptions to rules?		
Was an incorrect or out of date version used?		
Was the group hurried and did they take any shortcuts?		
	If there were "Yes's" in this column, this should be investigated further as a cause factor.	**If all of the rows indicated "No's", this may not be a cause factor.**

Corrective Action Guide

Categorization of Corrective Actions

1. ***Individual Factors***
   - ***1.1 Information Processing***
     - Lack of attention
     - Lack of memory
     - Poor decision making
     - Lack of experience / knowledge / training
   - ***1.2 Work Level and Design***
     - Ineffective workload
     - Improper expectations
     - Physical limitations
   - ***1.3 Health and Well Being of Employees***
     - Personal factors
     - Lack of nutrition
     - Health problems
     - Stress
     - Fatigue
     - Alcohol/drugs
2. ***Factors Related to Interaction with Others***
   - ***2.1 Communications and Group Interaction***
     - Miscommunications
     - Poor interactions within the group
     - Poor interactions between groups and other functions
   - ***2.2 Management and Unions***
     - Organizational factors
     - Lack of supervision
     - Associations and unions

3. ***Factors Related to the Software (Policies, Procedures and Environment)***
   - ***3.1 Procedures and Documentation***
     - Poor written information
     - Ambiguous rules and standard operating procedures
     - Not meeting regulatory requirements
   - ***3.2 Environment***
     - Poor immediate environment
     - Remote environment

4. ***Factors Related to Interaction with the Equipment and Other Hardware***
   - ***4.1 Workspace and Environment***
     - Poor workspace and lack of comfort
     - Poor physical space and arrangement

Corrective Action Guide

Example of possible corrective actions

1. Individual Factors

1.1 Information processing

- Lack of attention
- Lack of memory
- Poor decision making
- Lack of experience / knowledge / training

Possible Corrective Actions:

Slips, Lapses

- Job aids / memory aids
- Pre-job briefing checklists
- Information to employees regarding tips and techniques to reduce memory related errors
- Report training deficiencies to training group
- Address equipment issues which may have contributed to the incident
- Rotate tasks which are very common / monotonous among employees
- Alter automated task to require conscious attention
- Posting applicable rules in appropriate / high risk locations
- Remove / reduce unnecessary distractions from the environment
- Consider location and design of current last line physical defenses (e.g. derails, switch targets, warning signs and buzzers, PPE, guardrails, etc.)
- Change safety posters and warning signs on a regular basis

Mistakes

- Focus in safety meetings on infrequently used procedures / rules (e.g. emergency)
- Individual or group re-training / refresher
- Mentoring
- Posting applicable rules in appropriate / high risk locations
- Presentation at safety meetings by employee(s) involved

Possible Corrective Actions: (cont'd)

- Consider location and design of current last line physical defenses (e.g. derails, switch targets, warning signs and buzzers, PPE, guardrails, etc.)
- Orientation to territory / job / facility
- Report training deficiencies to training group
- Provide training when new equipment or new procedures are introduced
- Provide informal training to transferred employees on equipment / policies which are different at the old location
- Period of on-the-job training

Violations

- Mentoring
- Provide training when new equipment or new procedures are introduced
- Address equipment issues which may have contributed to the incident
- Increased proficiency testing in areas related to violation
- Presentation at safety meetings by employee(s) involved
- Consider location and design of current last line physical defenses (e.g. derails, switch targets, warning signs and buzzers, PPE, guardrails, etc.)

Corrective Action Guide

Example of possible corrective actions

3. Factors Related to the Software (Policies, Procedures and Environment)

3.1 Procedures and Documentation

- Poor written information
- Ambiguous rules and standard operating procedures
- Not meeting regulatory requirements

Possible Corrective Actions:

Slips, Lapses

- Ensure forms are laid out in logical order (chronological, related items next to each other, etc.)

Mistakes

- Ensure all required documentation is available to employees
- Ensure expectations are understood by all employees
- Ensure changes are clearly communicated to employees
- Report any rules which are unclear/ ambiguous/ misunderstood to rules and or training departments
- Ensure all documentation is up to date
- Presentation by employees involved at safety meetings
- Use of videos
- Engage in combined initiatives with unions and health and safety committees

Violations

- Ensure expectations are understood by all employees
- Report any rules which are unclear/ ambiguous/ misunderstood to rules and or training departments
- Increase proficiency tests to ensure rule compliance
- Presentation by employees involved at safety meetings
- Use of videos
- Ensure all requirements and qualifications are up to date for all employees and managers
- Add rule compliance / proficiency testing into safety framework
- Ensure the safety framework process is being used
- Engage in combined initiatives with unions and health and safety committees

International Rail Safety Conference

2000 LONDON

8 November - 10 November 2000
Forum Hotel, London, United Kingdom

Paper 0007

Rob Burrows

Promoting Human Factors in Rail Safety Management in Australia

Publisher
2000 International Rail Safety Conference

International Rail Safety Conference

Rob Burrows

Director, Office of Rail Safety

Department of Transport, Western Australia

Promoting Human Factors in Rail Safety Management in Australia

TRANSPORT
Rail Safety

International Rail Safety Conference 2000

Promoting Human Factors in Rail Safety Management in Australia

Rob Burrows
Director, Office of Rail Safety
Department of Transport
Western Australia
September 2000

HUMAN FACTORS IN RAIL SAFETY MANAGEMENT IN AUSTRALIA

Introduction

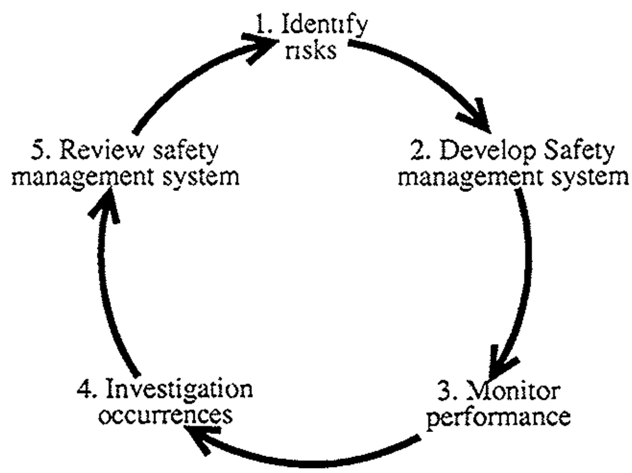
We have often read that 80% of rail, air and marine accidents are caused by human error. The mistakes are often triggered by a simple error that could have been prevented if human factors had been taken into account when the system was designed.

Many jurisdictions try to focus on learning from these mistakes. However a more proactive approach is required. As well as learning from mistakes we need to build a culture where human factors are vigorously applied throughout the safety management cycle. This includes when rail safety systems are designed and managed.

Knowledge of human factors is not new. It is possible to find examples where the interface between the human and the technology is considered. These include in fatigue management and the design of driver shift rosters or the use of ergonomics in locomotive cabin design or design of control panels. Less evident is application of behavioural science knowledge such as error types and how they can impact on safety.

Approach to Improving Safety Management

Australia has been implementing a State based co-regulation model for rail safety regulation. Part of this requires all accredited railway owners and operators to adopt a rail safety management cycle that includes these key steps:



Rail Safety Management Cycle

Underpinning the co-regulatory approach to rail safety in Australia is the *Intergovernmental Agreement on National Rail Safety"* (better known as the IGA). This was signed by State. Commonwealth and Territory Transport Ministers in 1996. It is a keystone document where the parties agreed to develop and implement a consistent approach to rail safety management across Australia.

The State based rail safety regulators work both together and with industry to ensure a relatively consistent approach to rail safety regulation and safety management is applied across Australia. The regulators have been documenting a set of key business processes to guide their individual and collective work. The regulators also meet with industry representatives at the Rail Safety Consultative Forum. The philosophy and objectives of rail safety regulation and management receive a fairly solid development and implementation test via these arrangements.

While no broad strategy for safety management has been documented it is clear from our work that key tools in the strategy include:

1. Requiring the application of Australian Standard AS4292 which defines the minimum requirements of a documented rail safety management system:
2. Encouraging railway managers to adopt best practice rail safety management methods. This includes encouraging railways to apply human factor knowledge in their safety management cycle and to adopt a more pro-active approach to safety management.
3. Encouraging the sharing of knowledge and experience (pre and post accreditation) by regulators and rail owners and operators.

Human Factors in Rail Safety Management

Within the above strategy it is emerging that several key developments will assist in improving the knowledge, understanding and application of human factors in safety management. These include:

1. The IGA Panel of independent investigators;
2. A report "*Independent Investigation and Open Reporting of Rail Occurrences*" approved by Transport Ministers in April 1999;
3. Drafting of a new Australian Standard "*AS4292.7 Rail occurrence investigation*";
4. Establishment of the Australian Transport Safety Bureau (ATSB) in 1999:
5. The Rail Safety Regulators' Communication Strategy: and
6. Lessons from the Zanthus collision.

IGA Panel of Independent Investigators

The IGA includes a requirement to establish a national panel of investigators who are available to independently investigate occurrences involving other railways. The panel includes a number of railway employees, consultants and ATSB investigators nominated to the panel by a State or Federal Ministers. Most of the Panel members were drawn from industry but recent developments have seen a flood of ATSB nominations. Safety regulators and railway companies may call on Panel members from other railway companies or ATSB to independently investigate accidents.

The intention was for ATSB's predecessor organisation, the Bureau of Air Safety Investigation (BASI), to train these investigators in the systemic investigation methods. This includes looking at the totality of an occurrence, the 'latent' and 'active factors', the effectiveness of safety management systems, and an assessment of human factors. However the Commonwealth Transport Department failed to organise this. It is hoped that membership of the Panel can be diversified and that the ATSB will provide some leadership by helping to arrange the training.

Report on Independent Investigation and Open Reporting of Rail Occurrences

In 1997 State Transport Ministers in Australia held a Rail Summit with industry to review progress in reforming the rail industry. They agreed that consideration should be given to implementing independent investigation and open reporting of major rail accidents in a manner akin to those undertaken by the then Bureau of Air Safety Investigation (BASI). The proponents of this project felt it could be an improvement to introduce independent aviation style investigations to rail with the purpose of publishing reports that others could learn from.

I was appointed leader of a small project team to research the matter and I wrote the resulting report "*Independent Investigation and Open Reporting of Rail Occurrences*". Recommendations in the report were approved by Transport Ministers in April 1999 and State safety regulators are implementing them now.

As the report developed it became increasingly evident that more powerful safety benefits are possible by working to build systemic safety thinking into the total safety management cycle applied by individual railway companies. In particular I saw the need to focus on promoting wider use of human factors knowledge in our co-regulatory approach to rail safety management in Australia and to help build a more open or pro-active safety culture in our railways. In a new 'no blame' or 'just' working environment people would be encouraged not only to share and learn from mistakes but also to contribute to planning, management and continuous improvement of the rail safety system.

The report aims to promote wider use of independence in investigations and also the development of more open and pro-active safety cultures in railway companies. Discussion and recommendations included proposals to support this including:

1. Open reporting to assist in the sharing of lessons. This includes publication of independent investigation reports;
2. Pro-active reporting of data trends and other information to assist in safety improvement;
3. The need for rail occurrence data bases to capture information on contributing factors such as human errors so that trends could be better assessed;
4. Establishing investigations with a safety objective (no blame approach to identify safety risks) rather than a justice objective (who to blame);
5. Ensuring investigations are systemic in nature, consider human factors and aim to uncover causes and safety deficiencies;

6. Training of investigators to undertake systemic investigations including learning about human factors; and
7. The need to develop generic investigator competencies to support the above approach. Such competencies would be available for use by anyone in the industry.

The study considered independent accident investigation processes in a number of countries. The report proposed adoption in rail of a "no blame" investigation and reporting process based on processes followed by leading transport accident investigations organisations such as TSB (Canada), TAIC (New Zealand) and BASI (Australia).

Of particular interest was discussion surrounding Recommendation 8 that concerned training. The need to assist industry by developing a suitable set of generic investigator competencies was suggested and the safety regulators have asked ATSB to assist by doing that. The generic investigator competencies should then be used to develop appropriate training.

The objective is for all investigators on the IGA Panel to be trained in human factors and how to carry out systemic investigations. It is recognised that many persons in the rail industry are required to carry out investigations. However, most lack the training to carry out a full systemic investigation in the manner required. It is hoped that safety managers and rail employees used for internal occurrence investigations could also access the same training as Panel members.

Also important will be the role of the industry based Panel members in spreading the knowledge gained through training and the experience in investigating accidents in other railways. It is hoped that they will play a major role in applying this knowledge in their own organisations to help establish a more open and pro-active safety culture. Under their leadership it is hoped that railways will apply such learning in human factors in all aspects of the safety management cycle including safety design, planning, risk assessment, operation and investigations.

Drafting of a new Australian Standard "*AS4292.7 Railway safety investigation*"

A new Australian Standard "*AS4292.7 Railway safety investigation*" is now being drafted to provide guidance on investigation of rail occurrences. The process outlined in the above mentioned report is providing the basis for this standard which will include a checklist of human factors. It is also possible that the investigator competencies being developed by ATSB may be included as a guide in an appendix in the Standard.

Establishment of the Australian Transport Safety Bureau (ATSB) in 1999

The ATSB has been formed as a multi-modal transport investigation agency similar to the TSB in Canada. It will include a rail investigation capacity. I see it must also take on a leadership role of assisting industry to achieve the culture change addressed earlier in this presentation through training and information exchange.

Recently ATSB began running an excellent week long course titled *"Human Factors for Transport Investigators"* to which it invites participation from across the transport industry. I attended in May this year and can advise that the course provided a very valuable introduction to human factors generally. More importantly it reinforced my belief that while investigations show up system failures we must work pro-actively to prevent them. The important task is to promote use of the knowledge not only in investigation but also throughout the safety management cycle from design to operation and review.

The ATSB has provided advice in developing the draft Standard AS4292.7 and is working on the investigator competencies. It is hoped that ATSB will extend its role into assisting individual railway organisations with introductory human factors and investigation training.

ATSB is also required by the IGA to work with the safety regulators and develop a national occurrence database. The regulators have specified that this should have the ability to capture an extensive range of data related to rail occurrences including contributing factors and human factors data.

ATSB has signalled that it wants a stronger role in independent rail investigations. The safety regulators will generally welcome their involvement and as happened at Zanthus are likely to call on their human factors experts to participate in or lead investigations.

ATSB employs several behavioural psychologists who have developed expertise experience in human factors in aviation and marine investigation. We are hoping they will build on this to develop a centre of expertise and education role in human factors for transport safety management.

The Regulators' Communication Strategy

The safety regulators have developed a strategy that includes several means of communicating with industry. This includes holding safety forums with rail organisations to discuss safety issues and training and to promote information exchange across industry. The safety regulators have begun producing a newsletter and some are establishing websites. We are all seeking suitable case studies to include our communication.

I see that we need to increase use of these communication methods to promote application of human factors and the other concepts discussed in this presentation. Our aim in co-regulation must include sharing best practice and experience in human factor for the benefit of safety.

The Zanthus Collision (see attachment A for more details).

In August 1999 a major collision occurred between a passenger train and a freight train on the major east-west inter-state route. My office appointed an independent investigator selected from the IGA Panel. The investigator was appointed under new legislation prepared to support a systemic investigation with the objective of determining the contributing factors and not apportioning blame. A human factors expert from ATSB was appointed to the investigation team. The Reason Model was applied in analysing the factors surrounding the accident.

The investigation showed human factors at play. A driver opened a switch box and without thinking pushed a button causing the points at a crossing loop to switch in the face of a passing train. The train entered the loop and collided with a stationary train. The driver had no intention of switching the points at that time, but pushed the button in an 'automatic' fashion, apparently out of habit. The fact that he immediately realised his error and attempted to restore the points to the normal position indicates that he had not intended to move the points at that time. No action was taken against the driver as learning rather than blaming was our objective. The investigation clearly showed that there were inadequate "defences" built into the system. There was no mechanical or electrical interlocking system to prevent movement of the points in front of the approaching train and no mechanism to prevent the button being pushed inadvertently. Procedures were not sufficiently detailed to prevent out of sequence operation of the points.

James Reason would say that a simple "skill based" human error triggered the collision. This 'automatic' or 'absent minded' error type is similar to writing a letter in January and without thinking putting in the previous year in the date. A 'negative transfer' occurred as the skill regularly applied before interferes with performance in a new situation.

The investigation report included a statement that:

> "Skill-based errors occur in situations where a person performs a routine series of simple actions regularly, with the result that the actions can be performed with little conscious control. If the person intends to perform an action in a manner which is different to their habit, but is distracted and fails to consciously modify their behaviour, then the habitual but undesired action sequence may be performed inadvertently. Such actions have been shown to contribute to many industrial and transport accidents. It appears that the habit of the driver was to open the box and then push the reverse button immediately after. In this case, it seems that the act of opening the box led inadvertently to the act of pushing the reverse button."

Also the track owner had not taken human factors into account in previous risk assessments. After the accident the track owner built new "barriers" or "defences" into the system to prevent the same type of human error being repeated. These included new switch protection and procedures.

We believe that if knowledge of human factors had been applied in the initial design of the system the new form of protection could have been installed for an insignificant cost. As it was the estimated cost of damage to rolling stock at Zanthus was about $6 million AU (£2.4 million) and the improvements to the switch control box mechanisms across all 47 crossing loops was $162,000 AU (£63,180).

The Zanthus collision was included in the last ATSB *Human Factors for Transport Investigator's* course and provided an excellent example of human factors at work. It clearly demonstrates the benefits of applying human factors in the safety management cycle and for working towards an open no-blame safety culture. Lessons from investigations such as Zanthus need to be better communicated with industry. However not many good rail examples appear to be available. For human factors training the ATSB currently relies on lessons from disasters in other transport modes, particularly aviation. These include disasters at Teneriffe and on the Piper Alpha oil rig. While these are excellent examples and the lessons can be transferred to rail safety management there is a need to gather more rail specific examples.

Conclusion

While our strategy has been slow in developing change is happening and progress is evident in the more progressive rail companies.

The critical factors will be leadership and the ability to develop a "no blame" or "just" approach coupled with good cross industry communication of stories and successes, problems found and solutions. All of this is part of establishing a learning environment in which the rail industry embraces the concepts of continuous safety improvement.

The lessons from accident investigations such as at Zanthus will be used to promote the benefit of considering human factors in the safety management cycle.

While learning from investigations could be deemed learning from mistakes it is clear that our goal should be to encourage railway managers to learn more about human factors generally and to a proactively apply the knowledge in all their rail work.

If management of human factors can be improved then their reported major contribution to 80% of accidents can be significantly reduced.

Footnote

In a recent meeting with a senior safety manager our discussion was interrupted by a phone call. When finished the manager said:

> "Rob that wouldn't have happened three years ago. That guy just rang up to report he had made a mistake and could we have a look to see if the procedure needed to change. Before they would have just tried to cover it up."

Attachment A

ZANTHUS RAIL COLLISION

SUMMARY OF INVESTIGATION

Location:	Zanthus, Western Australia (on the major east-west inter-state route).
Occurrence Classification:	Mainline collision
Date:	Wednesday 18th August 1999
Time:	1706 hours WST
Safeworking system:	Train order system.
Trains involved:	Indian Pacific passenger train No.3AP88 with 181 passengers, 16 staff and 5 crew travelling from Adelaide to Perth. Consisted of nineteen (19) coaches and locomotive NR15 totalling 469 metres in length with a trailing gross load of 838 tonnes. Freight train No 3PW4N travelling from Perth to Whyalla. This freight service was stationary in the crossing loop. It was only partly loaded and comprised of twenty seven (27) wagons, 542 metres long and with a gross weight of 713 tonnes.
People involved:	Indian Pacific had 181 passengers and 16 on train staff plus 2 train crew. Freight train had 3 train crew.
Injuries:	31 passengers and 16 on train staff reported injury or side effects. 21 people (17 passengers and 4 train crew) were taken to Kalgoorlie Hospital by air. One remained in hospital for several weeks. Cost not known. One crew member from the freight train suffered a bruised arm and was off work for about two weeks.
Track damage:	Nil.
Infrastructure damage:	Nil.
Rolling stock damage:	Damage to Great Southern Railway passenger vehicles occurred in varying degrees of severity to all 19 coaches from minor internal damage to severe under carriage damage. Luggage/smoking lounge car HM311 sustained extensive damage and was written off. Significant damage sustained to locomotives NR51, NR15 and passenger coaches. Estimated cost of damage to rolling stock was $6 million AU (£2.4 million). The east west rail link at Zanthus was closed to interstate train operations for 20 hours.

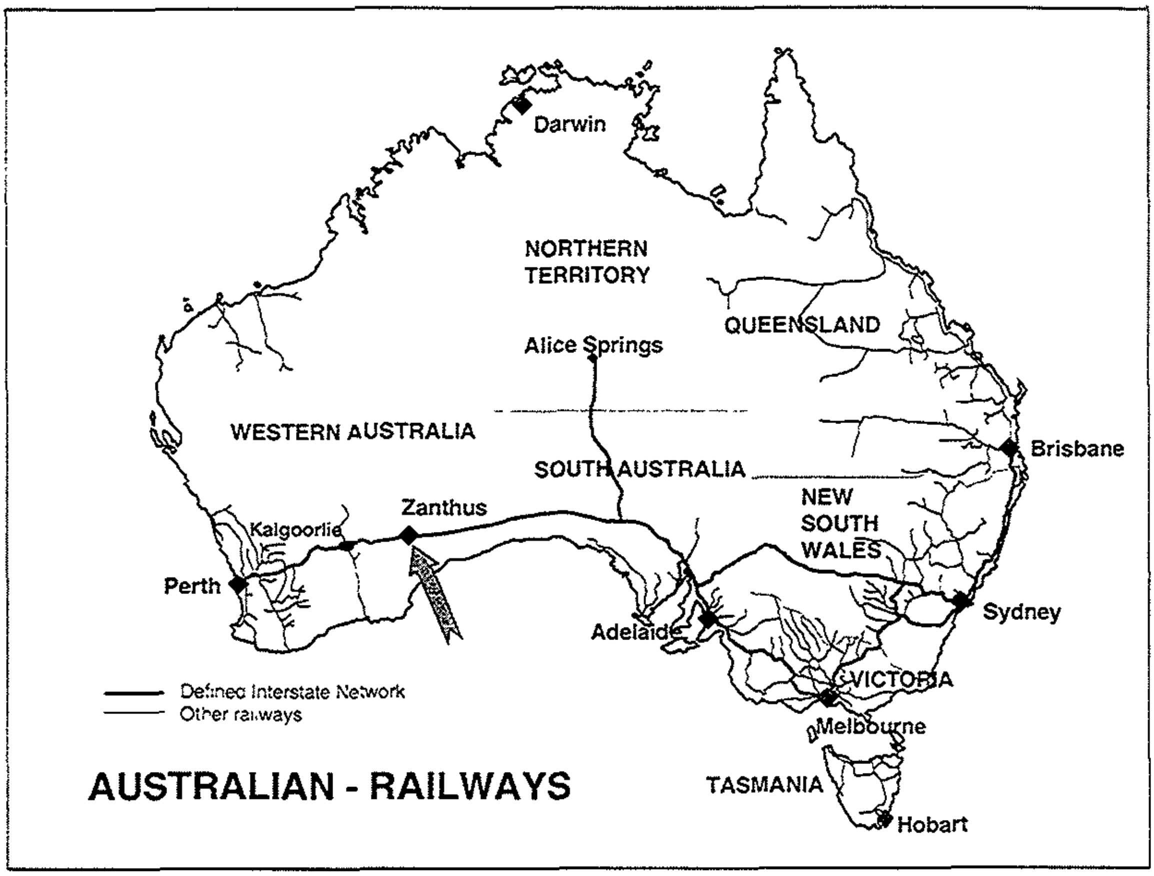


Figure 1: Location of Zanthus

<u>The Investigation</u>

The Western Australian Office of Rail Safety appointed an independent investigator selected from the IGA Panel of Investigators. The investigator was appointed under Western Australia's *Rail Safety Act 1998.* This relatively new legislation includes strong provisions designed to support an independent systemic investigation with the objective of determining the contributing factors and not apportioning blame or liability. Witnesses were required to answer questions and given protection from self-incrimination.

A human behaviour factors expert from Australian Transport Safety Bureau (ATSB) was appointed to the investigation team. The result of the investigation showed human factors at play.

The Reason Model was used in analysing the factors surrounding the accident.[1]

A driver accidentally pressed a button that triggered the point switching gear into action thus changing the setting of the main line points from normal to reverse and diverting train 3AP88 on to the loop where it collided with the stationary freight train.

[1] The Reason model of accident causation has become one of the most widely applied systemic approaches to accident analysis. Reason maintains that accidents generally arise from a combination of immediate active failures that trigger the accident, and pre-existing system failures which create the circumstances in which the accident occurs.

There was no mechanical or electrical interlocking system to prevent the movement of the points in front of the approaching train.

In human factor terms it was determined that a simple "skill based" human error triggered the collision. However there were no effective "barriers" built into the safety system to prevent the events that followed. Also the track owner had not taken human factors into account in previous risk assessments. No action was taken against the driver as learning rather than blaming was our objective.

The track owner initially instituted procedural measures to prevent a similar occurrence in the short term. In 2000 a system upgrade was completed to provide a time interlock mechanism in the crossing loop control boxes. The mechanism is designed to prevent accidental movement of the points. When the control box is opened the push buttons won't activate for 90 seconds. When that time has counted down the push buttons can be activated. Therefore pushing the buttons must now be a deliberate decision and not an accident.

The new switch protection and procedural changes will be effective "barriers" in preventing the same type of "skill based" human error being repeated.

If knowledge of human factors had been applied in the initial design of the system the new form of protection could have been installed for an insignificant cost.

The experience with this event now provides a powerful example for communicating the benefits of applying human factors in risk assessment and ongoing safety management and for demonstrating the benefits an open pro-active safety culture.

Key Points Made in the Investigation Report

Sequence of Events

Freight train 3PW4N was stationary in the loop. The headlight of passenger train 3AP88 was noticed approaching The driver on 3PW4N admitted the approaching train 3AP88 to the main line at Zanthus by a radio message confirming that the east end points were set for the main line.

A crew member alighted from train 3PW4N to do the roll by inspection. He walked to the east end points, checked the setting, then moved to the equipment room and stood near the points push button control box. The driver remaining on 3PW4N noticed this crew member open the push button control box.

The driver on the ground at the points indicated that on noticing train 3AP88 coming down the hill into Zanthus he checked the points, watched the train approach, opened the push button control box and without knowing why and not remembering, pressed the button to set the points for the loop. At this stage he reported he was not thinking about what he was doing but what he had to do when he got to Cook. When he heard the points motor going and saw the points starting to move, he immediately pushed the green button to alter the points travel, however, the points continued to travel to the reverse position. This is a normal feature of motor driven points.

From about 2 kilometres the crew of 3AP88 could see the flashing light indicator was green indicating that the points at Zanthus had been set for the main line.

The Australian Rail Track Corporation Code of Practice stipulates 50 kph as a maximum speed for the train taking the main line for a cross. Train 3AP88 made a controlled approach to the east end facing points to allow a roll by inspection of the train by the crew of 3PW4N. The train speed dropping gradually from 111 km/hr, at a distance of approximately 3.3 km from the east end points, to 52 km/hr at 58m before the facing points. Both drivers noticed the flashing light indicator change from flashing green to flashing red at a distance of 50 to 150 metres from the points.

It was at this point that an emergency brake application was made when the train crew noticed the east end facing points move from being set for the main line across to the crossing loop and the flashing green indicator light change to flashing red. Although under full braking, the train travelled a further 148 metres from the point of emergency brake application before colliding with NR51, the locomotive of the stationary train no. 3PW4N. The force of the impact pushed locomotive NR51 eight metres back along the loop towards the west end points. The speed of 3AP88 was 50 kph when the emergency brake was applied and 27 kph at impact.

As train 3AP88 approached the driver in the locomotive of train 3PW4N noticed the points were starting to turn. Realising what was about to occur, he jumped from the locomotive towards the main line and took himself clear of the locomotive. Following the collision, he returned to the cab of the locomotive and rang National Rail Strategic Operation Control.

The driver who activated the points claimed not to have had more than fifteen to twenty hours sleep from Friday, 13 August up to the time of coming on duty at 1135 hours on Wednesday 18 August. He had taken a decongestion cough mixture on Sunday 16 August and took some cold and flu tablets on Tuesday 17 August.

The crew had experienced a 42 hour break from driving prior to this shift and indicated that at Cook a minimum of eight hours is available on this roster with breaks as long as 12 hours. The break at Cook on this occasion was rostered to be 19 hours. 20 minutes.

Following the accident, a standard assessment was carried out by a Clinical Neuropsychologist to evaluate whether the driver on the ground had been suffering from any pre-existing neurological conditions which may have impaired his job performance. No evidence was found to indicate that the driver was suffering any such condition.

Findings (from the report)

- The crew of 3PW4N had resumed work at 1135 hours after a break of 42 hours.
- Train 3PW4N successfully operated a cross at Blamey.
- All drivers were qualified for their assigned task.

- The collision occurred in daylight with good visibility.
- Both trains received after fulfilling "Train Orders" for travel beyond Zanthus
- The crew of train 3AP88 operated the train in a professional competent manner.
- The crew of train 3AP88 confirmed the mainline setting of the points.
- The flashing green light indicator was clearly visible to the crew of 3AP88.
- Setting of the eastern end points for the mainline confirmed by a workman at the western end after admitting 3PW4N to the loop.
- Crew of 3AP88 requested admittance for the mainline.
- Driver of 3PW4N admitted 3AP88 and confirmed points set for the mainline.
- Driver on 3PW4N saw the driver on the ground open the push button control box.
- Driver on 3PW4N saw points change from main to loop in front of 3AP88.
- Driver at the equipment room remembers opening the push button control box.
- The driver stated that he did not know why he pushed the points reversing button.
- The driver stated he could not remember pushing the button.
- The driver on hearing points move and seeing them start to turn pressed the normal button.
- Both drivers of 3AP88 saw the flashing light indicator change from green to red and the points move from the main line to the loop.
- Emergency brake application made by driver of 3AP88 at 58 metres from the points.
- Train speed at impact was established as 27 kilometres per hour.
- No mechanical or technical failures in the points, track or rolling stock contributed to the accident.

Significant Factors (from the report)

- The system in place on the day of the accident was unable to cope with the human error.
- There were no mechanical or electrical defences in place to prevent the points button being pushed in front of the train.
- Procedures on the part of owner and operator governing driver behaviour were not sufficiently detailed to specifically prevent out of sequence operation of the points.

Key Issues Raised in the Investigation Report

The investigation determined that:

- no mechanical or technical failures in the points, track or rolling stock contributed to this accident.
- human error was the triggering event that immediately precipitated this accident. While flawless human performance is a worthy aim, it is in reality rarely

achievable. It is apparent that the system in operation at Zanthus relied on perfect human performance to ensure safety.

- In common with most accidents, the collision at Zanthus involved an 'active failure' committed by a person. This was the error of pushing the points reverse button as the Indian Pacific was approaching the main line facing points. Almost certainly, the driver intended to open the push button control box and then wait for the train to pass before pushing the points reverse button. This action was almost certainly a 'skill based' error in the sense that the person who committed it had no intention of performing the action at that time, but pushed the button in an 'automatic' fashion, apparently out of habit. The fact that he immediately realised his error and attempted to restore the points to the normal position indicates that he had not intended to move the points at that time.
- The driver's error in moving the points at the wrong time was not an isolated event. In April 1996, a freight train was derailed at Malbooma when the points were inadvertently changed as the train was passing over the points. In addition, information was obtained in the course of the Zanthus investigation indicating that several drivers have nearly pushed the reverse button at the wrong time, but had stopped themselves from doing so at the last moment. Clearly the potential existed to commit a skill-based error and change the points at the incorrect time and there is a need for stronger defences either to prevent such errors occurring, or to minimise their consequences should they occur.
- The driver in question reported that over a period of five days prior to commencing duty he had experienced only 15 to 20 hours sleep and had taken decongestion cough mixture and cold and influenza tablets. Having experienced all of this lack of sleep he still presented himself for work. This could be considered a possible second failure in reporting to work because of an admirable sense of loyalty and commitment to the company. However, it could be argued that a person who has experienced this small amount of sleep over an extended period should not have been at work.
- Opening the box and accessing buttons before a train has passed clearly increases the potential for human error. Yet at the time of the accident, there was no detailed standard procedure to regulate how drivers should go about changing the points at crossing loops. An operating procedure issued by the track owner clearly identifies what a driver must do to exit a crossing loop but does not specify any mandatory order of action.
- It is quite clear that the practice of opening the push button control box prior to the arrival of a train to carry out a cross is normal practice.
- Procedures for carrying out roll-by inspections and crossings are outlined by the train operator and the track owner. Respectively, while the track owner specified procedures to be observed by operators, these did not extend to a sufficient level of detail. The rail operator specified operating procedures for its drivers however, these also, did not specify in detail the procedures to be followed at crossing loops.
- It was not clear during this investigation whether the responsibility for specifying such procedures lies with the track owner or the operator. Because there are a number of operators that have trains traversing the Trans Australia Railway, there is a need to resolve this ambiguity and ensure that safety-critical procedures are specified at an appropriate level of detail.
- the management of risk is an integral part of the rail safety management process. Risks can derive from sources such as natural events, technological issues and

human behaviour. In October 1997 a risk analysis of safeworking systems was prepared for Track Access, South Australia. In considering the Train Order Working system the report concluded that;

> "The primary risk factor is the almost total reliance on the integrity of the staff using the same (ie the human factor). It is the professional opinion that Train Order Working as and where employed by Australian National has not been considered in terms of the human element and the potential for human error." That report recommended that the current system be replaced with a new system designed with human fallibility in mind.

- In October 1998 a review of safeworking systems and safety management was prepared for ARTC. This report stated that previous comments contained in the 1997 report were still relevant. However, it also acknowledged that some significant amendments had been made following the recommendations contained in the October 1997 report, specifically in the procedures for Train Order Working. Conditional Train Orders had been prohibited and drivers must speak to Train Control at the loop immediately preceding a booked crossing. The report stated that; "This is a positive enhancement to the safety of what continues to be an exposed system of Train Control but has significantly reduced some of the risks inherent in the system."
- Incident databases in most Australian industries have traditionally focused on technological or mechanical failures and generally contain little information on the human performance failures that present risks to the system. This is despite the fact that human behaviour is the largest contributor to accidents in complex technological systems such as rail transport.
- All states in Australia maintain rail incident databases. The information is reported to a central agency that has the responsibility to identify potential safety hazards. However, the lack of human factor data in the database, and the lack of satisfactory data analysis has resulted in a failure to identify proactively system risks.
- There was no formal procedure specifying in detail how the crossing should be accomplished. A checklist or other formal procedure to guide the driver may have reduced the likelihood of an error occurring.
- The system, which existed on the day of the accident, was not error-tolerant. In particular, there was no locking system or other method to prevent inadvertent activation of the points.

Safety Actions (from the report)

The track owner Australian Rail Track Corporation issued the following train notice with the following instruction:

TO ALL CONCERNED:

ALL SAFEWORKING EQUIPMENT AND ASSOCIATED ENCLOSURES MUST REMAIN LOCKED UNTIL REQUIRED FOR ACTUAL TRAIN WORKING.

OPERATION OF THE EQUIPMENT MUST AT ALL TIMES BE CONDUCTED WITH DUE CARE AND CONSIDERATION FOR ALL TRAINS IN THE VICINITY AND IN ACCORDANCE WITH THE REQUIREMENTS OF THE CODE OF PRACTICE.

APPROPRIATELY QUALIFIED MAINTENANCE CONTRACTORS MAY OPERATE SAFEWORKING EQUIPMENT FOR THE PURPOSE OF MAINTENANCE AND TESTING ONLY AFTER GAINING APPROVAL TO DO SO HAS BEEN OBTAINED FROM TRAIN CONTROL.

ARTC also made a change to the system by installing a door switch in the push button control box at each main line set of points and crossovers. This door switch is to be protected from inadvertent operation and will provide a 2-3 minute time delay in the normal and reverse operation of the points.

The modification of the new system consists of an electrical switch that detects the opening of the door of the push button enclosure. When the door is open, the switch will result in the following two activities:

- A contact of the switch opens and places the enhancer to the red indication. This is achieved by the door switch contact being directly in the coil circuit of the searchlight relay. The red indication will be displayed at all times when the door is open.
- The point machine control push buttons will not accept a command until a timer circuit has counted down from a predetermined value (90 seconds implemented). At the expiry of the count down period, a Light Emitting Diode (LED) mounted on the panel on which the push buttons are mounted will show a steady white light indicating that the points will now accept a command. It will not be possible to lodge a command until the count down is complete; the system will ignore all activity on the push buttons until the time delay has elapsed.

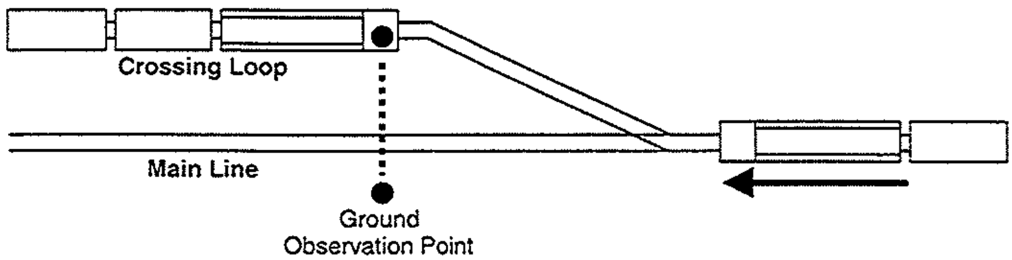
At the end of the countdown, the points may be moved using the push button, but the enhancer will display a red indication until the push button box door is closed, at that time, the enhancer will display an indication consistent with the position of the points.

National Rail Corporation issued a Notice that identifies where train crew are to position themselves for a roll-by Inspection but does not offer advice as to when the train crew should activate the points control buttons. It said in part:

> "When admitting trains to crossing locations, a roll by inspection of the train is to be performed by the Locomotive Drivers, where ever it is safe and practical to do so:
>
> When crossing or passing trains

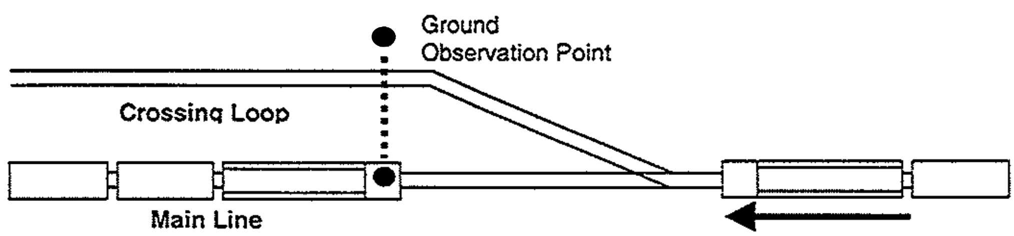
- After being relieved en route or in a yard
- At crew change and depot locations
- When arriving or departing trains into or from any yard where no qualified employees is present

At crossing loops and where infrastructure arrangements and/or ground conditions allow it to be done safely, one crew member is to be positioned in line with the locomotive on the opposite side of the main running line, ie:



Crossing or Passing Train through Main Line

At crossing locations where the stationary train is standing on the main line and the crossing train is to be admitted to the loop, where infrastructure arrangements and/or ground conditions allow it to be



Crossing or Passing Train to Take Crossing Loop

done safely, one crew member is to be positioned in line with the locomotive on the opposite side of the crossing loop, ie:
When crossing or passing trains at night, one driver should remain on the locomotive to operate the headlight on full beam when appropriate."

Recommendations

The following recommendations were made:

1. Where there are vital safety-critical activities required to be executed, procedures should be provided with sufficient detail to ensure that what should occur does and in the correct sequence.

2. A risk analysis involving the human factor aspect of vital safety critical activities should be considered in framing procedures.
3. When trains are to effect a cross or a pass at a siding it is suggested that consideration be given to bestowing the person in the drivers seat at the time the responsibility to ensure safeworking procedures are effected correctly by the observer.
4. Provision of a checklist to be completed by the first train into either the loop or the main, which will prompt a correct procedural process, should be given consideration. Insertion of time of activation of points may be beneficial.
5. On going dialogue between the two trains to be involved in the cross concerning the checklist in 4 above may provide appropriate attention to safeworking procedures at the critical time.
6. During crew rotation the driver coming on duty on board the locomotive must read and counter sign the active Train Order under which the train is operating.
7. The enhancement of holding the points from operating and displaying a red indication for a prescribed time to protect any advancing trains should be carefully monitored and evaluated in the initial stage following installation.

Where to Obtain a Copy of the Independent Investigation Report

As required under the *Rail Safety Act* the investigation report was published and can be downloaded from the Internet at the following address:

www.transport.wa.gov.au/linking/rail_safety.html

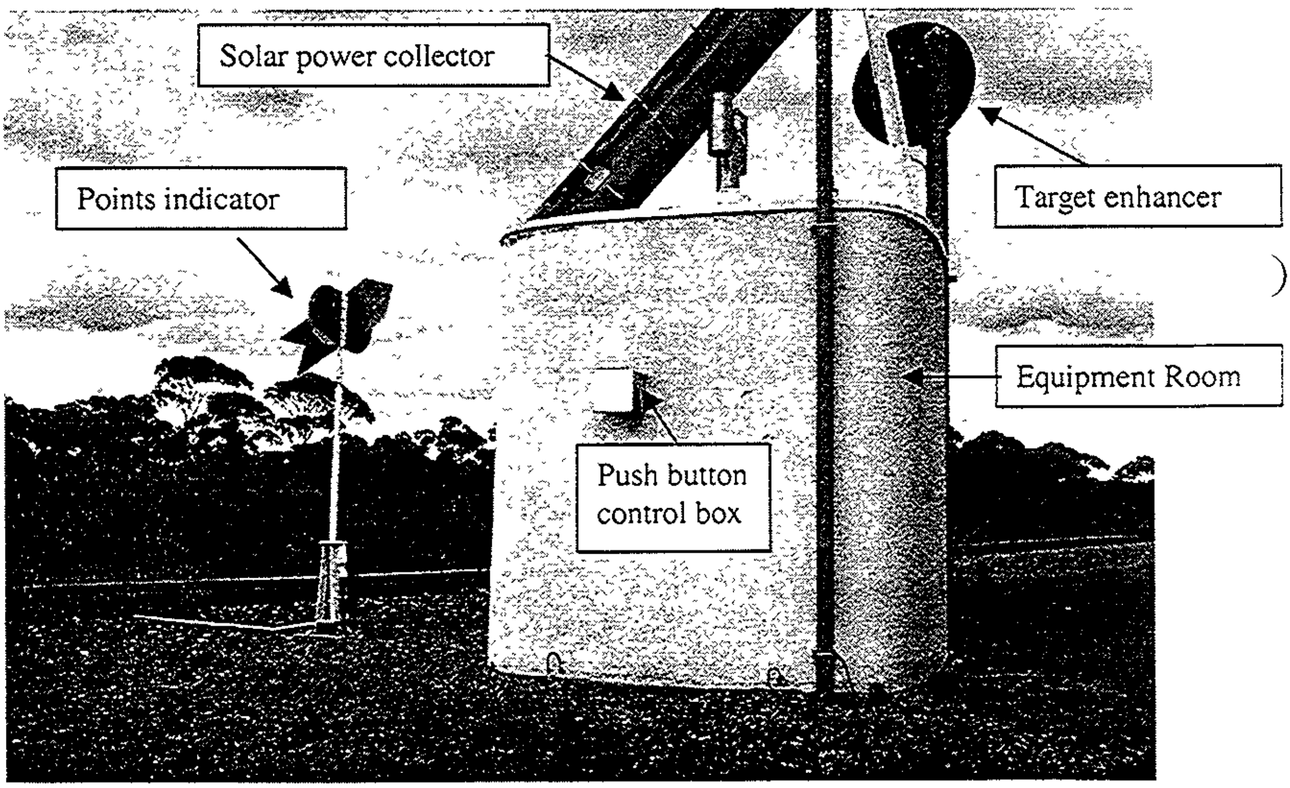


Figure 2: Infrastructure at eastern end of Zanthus crossing loop.

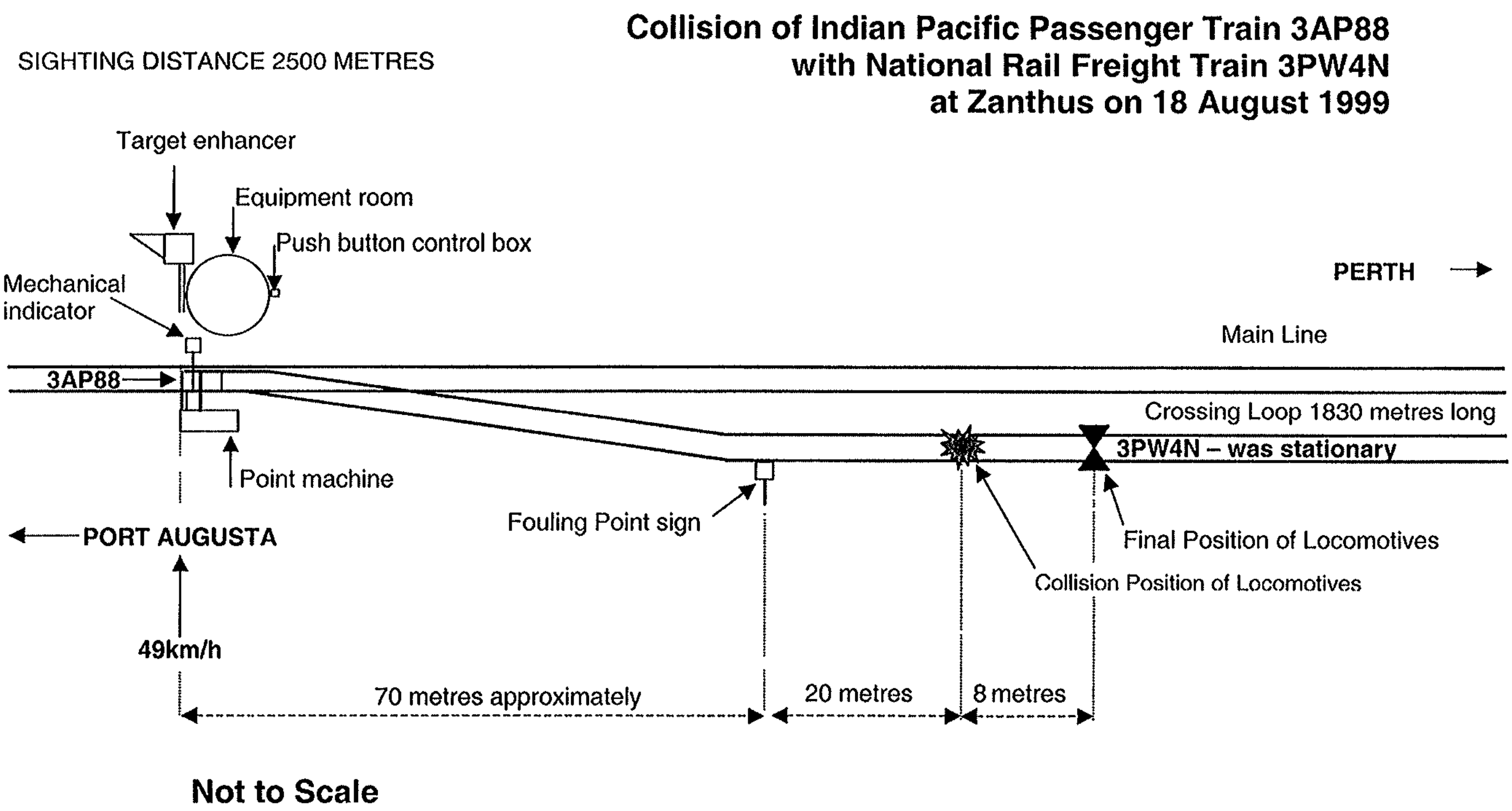


Figure 3: Schematic of Infrastructure at Zanthus Crossing Loop – Eastern End

Figure 4: Locomotives NR15 and NR51 nose to nose following the collision.

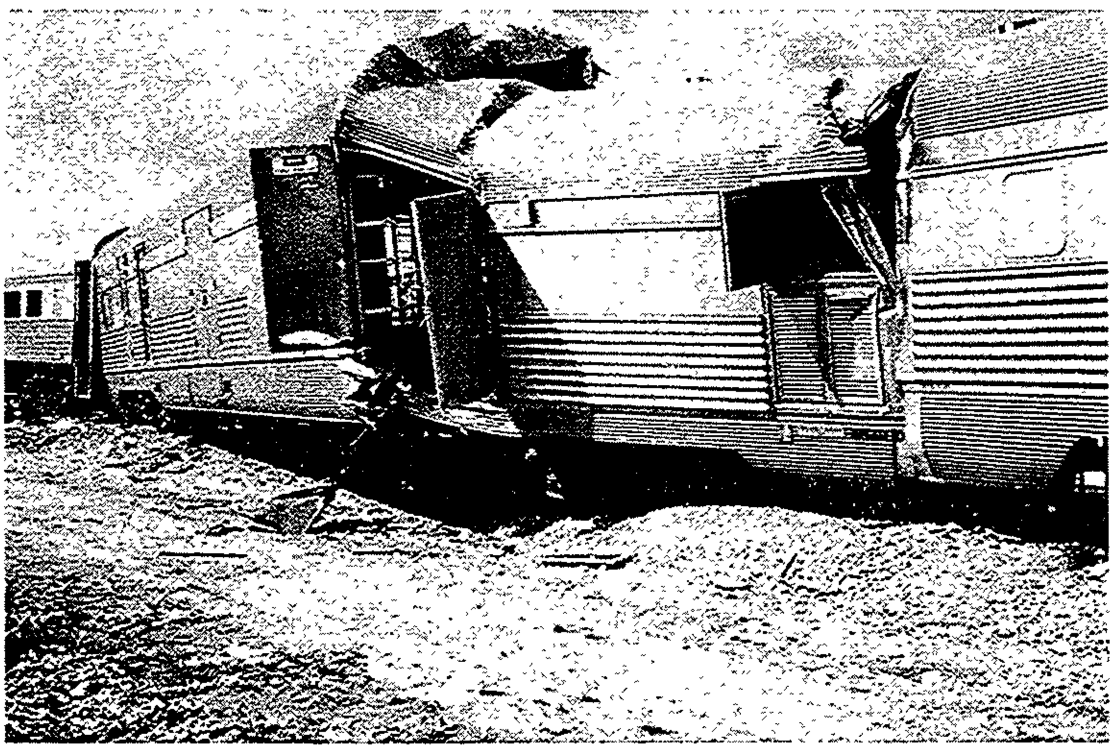


Figure 5: Damage to Indian Pacific Coach HM311.

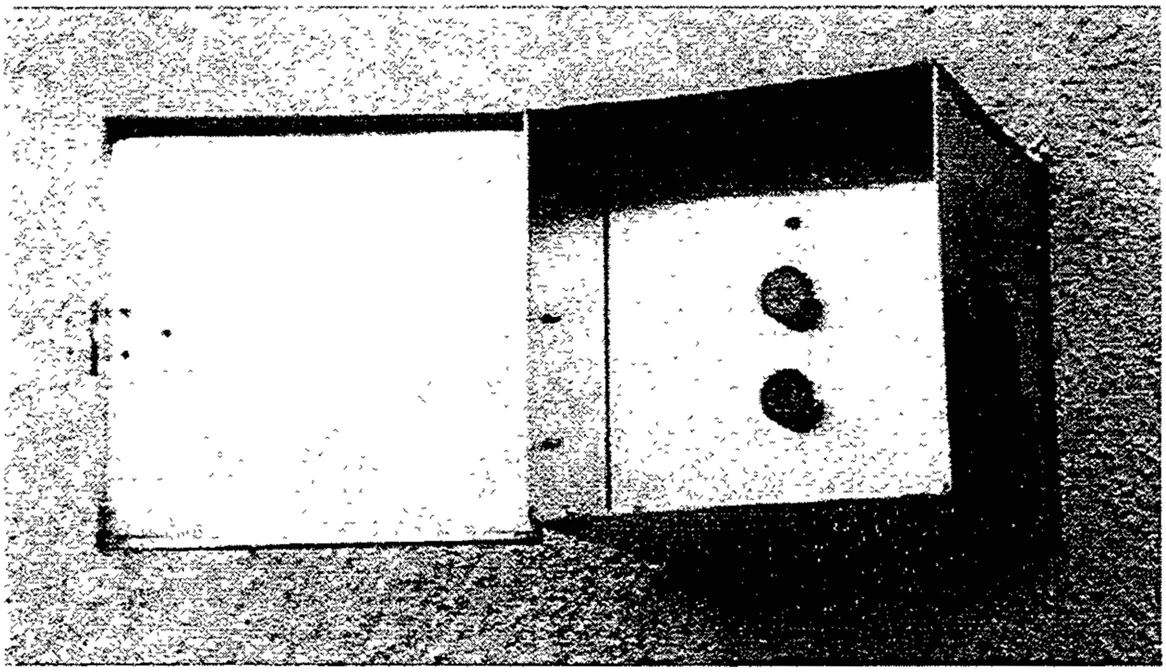


Figure 6: Control Box in original form at time of accident.

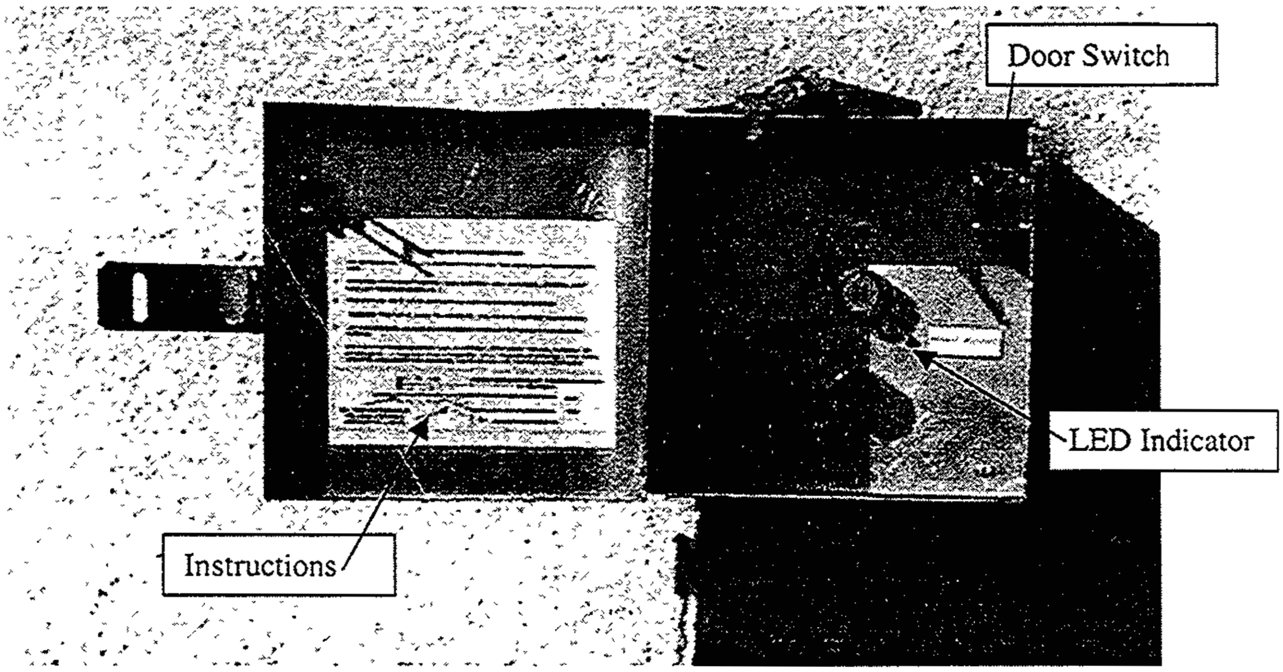


Figure 7: Control Box with modification after the accident investigation. Note the new door switch, instructions and indicator light.

International Rail Safety Conference

2000 LONDON

8 November - 10 November 2000
Forum Hotel, London, United Kingdom

Paper 0008

Gerald Churchill

Some Ways to Control Railway System Interfaces within RATP

Publisher
2000 International Rail Safety Conference

International Rail Safety Conference

Gerald Churchill

Deputy Director

RATP, France

Some Ways to Control Railway System Interfaces within RATP

Gerald CHURCHILL
RATP - ESE

The control of interfaces within a railway transportation system

1.Introduction

The study of a complex system definitely includes a modelling phase. The more precise and the more suitable the model is, the more successful and easy to control the system will be.

Modelling is traditionally used in system design. But this modelling proves to be very useful for railway safety, because it brings to the fore one of the weak links of the railway safety chain i.e. the interfaces generated by the different components of the transportation system.

After a description of the model, whose construction starts at the design phase and is used through out the life cycle, I am going to focus my presentation on the operation and maintenance phase to show how the model enables us to control the changes in the system.

2 The transportation system modelling

2.1 The RATP model

A product is above all the outcome of a functional need. Gradually, after a succession of options, these options resulting in sub-functions, the product becomes a finished product.

The finished product, including hardware and more and more software, is the first dimension of the system i.e. the technical system.

A complex product, for example a railway system, is also made up of men, in charge of the design, the operation and the maintenance of the system. They can modify the system if the original need has changed or if they have to rectify a malfunction.

These men represent the second dimension of the system i.e. the human system.

A complex product is generally dynamic. In order for the system to function correctly, structured organisational rules must be drawn up, formally outlined and applied.

These rules form the third dimension of the system i.e. the organisational system.

Finally, it is extremely rare that a system designed and built in this way, functions autonomously. The whole system is subject to environmental changes and vice versa.

This model is particularly suited to a complex product such as a railway system.

A railway system satisfies a transportation need, passengers or freight. It is made up of:
- A technical dimension: Rolling-stock, track, signalling, power supply, etc.

- A human dimension: designers, drivers, service engineers, supervisors, etc.
- An organisational dimension: operation and maintenance rules, etc.

A railway system is integrated into a complex geographical and climatic environment.

2.2 Interfaces

Modelling clearly highlights interfaces between the different components of the railway system (train, infrastructure, energy supply, information sub system, etc.). For the system to function successfully, the interfaces between the different components must be perfectly controlled.

For a railway system, as for every product, the functional need is characterised by a set of requirements, in particular the safety performance. For a railway system, these requirements must meet particularly high standards, due to the consequences on human life and impact on the media.

An interface is a vital link, because a malfunction at this level could lead to a imbalance within the system, that in terms of safety could lead to a serious accident.

2.3 The model analysis

Until now, the suggested model, only static, is not very new. To progress, it is interesting to animate it.

The system generates desired events, but can also generate undesired events. In my presentation, I am only speaking about safety related events.

At the commissioning, the system is expected to be perfect and stable. The interfaces between the three systems have been studied and integrated in the model. I consider this hypothesis as true, before looking at the life and the evolution of the system.

The three dimensions of the model are a priori of different type. The risk is that a change in of one of these dimensions has an impact on another one, leading to a discrepancy between prevention modes set up to prevent undesired events and reality.

I am going to analyse successively the possible changes of each model dimension, the likely impacts on the two others and the solutions RATP has found in order to control the concerned interfaces.

2.3.1 The interfaces of the technical system

The desired events of the technical system are, of course, the main transportation functions. These functions can evolve with time with the emergence of new needs. And these new needs lead to technical changes. It is the case, for example, of route modifications and their consequences on signalling equipment.

The technical system also generates technical risks. The severity of these risks depends on the system architecture and on the design of the involved components. Risk analysis during the design phase has normally led to the elimination or the reduction of these risks, thanks to design modifications, or operation rules, or maintenance procedures, or organisational changes.

In order to insure the control of the interfaces with the technical system, RATP uses the design tools. These tools carry out the concept of "in depth defence" with technical or procedural barriers. This concept of "in depth defence" is very well known in the nuclear industry. The idea is the introduction of several different types of barriers, at least two, more often three, in order to prevent the first failure immediately leading to an accident.

An example is the potential failure of the breaking system of a train. The first barrier is a technical barrier i.e. the redundancy of the breaking equipment. The second barrier is a human barrier i.e. the awareness of the driver.

The barriers, technical or procedural (men and organisation) barriers are described in the risk analysis. When a modification is studied, the risk analysis is updated and the concerned procedures are reviewed. Actually, it is a basic rule of quality assurance.

Moreover, learning from experience has a strong contribution to interfaces control. This also applies to a system whose risk analysis has never been carried out.

2.3.2 Human system interfaces

For men, the desired events are skills and motivation. With time, skills and motivation can evolve, due to staff turn over. Consciousness-raising campaigns and specific training must accompany such a turn over, in order to maintain a suitable human system.

The undesired events are human errors. Human errors are normally analysed during the design phase at the same time as technical failures. Specific analysis can be carried out.

Controlling human system interfaces is more difficult than controlling technical interfaces. In fact, due to the complexity of human beings, the model is not perfect. Concerning human system, RATP findings are the formal identification of simple behaviour principles, both for workers and designers. These principles are written in the same shape as the biblical commandments.

As for the technical system, if the human system evolves and if the interfaces are not controlled, training could be no longer apt to the original objectives and be less efficient in preventing human errors. Audits and inspection are regularly carried out to check the knowledge and good understanding of the basic rules of railway safety.

Similarly to the technical system, learning from experience allows discrepancies in the human system to be detected.

2.3.3 Organisational system interfaces.

The desired events of the organisational system are the structures and the associated procedures. With time, organisations evolve and the structural changes could lead to modification with consequences on the procedures.

The undesired events are risks at the interfaces of different equipment, which different services are in charge of. There are two classic examples. The first one is the communication between different workers with their own professional language, like drivers and service engineers. The second one is the rail-wheel interface whose safety objectives for the maintenance services (in particular rolling stock and signalling) are different. Sanding to improve breaking performance could make it more difficult for track circuits to detect the trains.

Until now, the interfaces of the organisational system have been the most difficult to conceive, therefore the most difficult to manage. But they are almost always involved in serious railway accidents.

To try to insure the control of the interfaces, RATP has created the new concept of the vital function manager. I am going to develop this concept later in my presentation.

Of course, as for the two other systems, learning from experience is a major tool to detect organisational system discrepancies.

3 The vital function manager

In order to respond to the concern for the organisational system interfaces, RATP's first idea was to set up an interface manager for every vital railway system interface, for example the rail-wheel interface.

This approach quickly appeared to be very complex, because it was necessary to know all the vital interfaces. Moreover, it was not durable, because a controlled interface under the responsibility of a single executive could become a vital interface if the responsibility is then shared as a result of a reorganisation project. No efficient tool may really detect the consequences of such changes because, the aim of a reorganisation is generally dictated by political objectives, rather than functional or technical needs.

After consideration, RATP preferred the concept of the vital function manager. Main vital functions are well known. They are durable and independent of the organisation.

The necessary actions to carry out a vital function management policy are the following:

- The main transportation functions have been identified (15 for RATP), for example guarantee train running control;
- The main functions have been broken down in detailed sub-functions. The objective is to clearly identify the main equipment and the associated responsibility;
- The major risks have been identified (16 for RATP), for example derailment;
- The functions and sub-functions involved in a major risk have been identified for each major risk;
- The contribution in terms of severity of each service involved in a vital sub-function has been assessed.

With this preliminary work completed, the duality in terms of responsibility is clear. The final task is to appoint the vital function managers. The vital function manager can be chosen from the involved services if one of them can be considered as predominant, or from a cross-services entity.

The analysis of a technical or functional change must then be carried out by the vital function manager. He assesses the consequences of the change in terms of safety and gives approval.

A specialised meeting on risk management, at top management level of the company, took place on May 20th. The vital function management had been presented and approved in its principles. It has been decided to apply the process to three specific examples:

- The rail-wheel interface;
- Distance spacing of trains;
- Ventilation and fume extraction.

4 Conclusion

This approach relies on the designer acceptance to transmit its modification file to the vital function manager. Even if we are still in the field of human behaviour, the new process is a significant step to achieve global control of the railway system safety.

It is an additional grain of sand on the beach, and as a Japanese proverb says : "Without the grains of sand, the beach would not exist".

References:
International railway safety conference - October 1999 - Banff - Canada.
International railway safety conference - October 1995 - Mayenz - Germany.

International Rail Safety Conference

2000 LONDON

8 November - 10 November 2000
Forum Hotel, London, United Kingdom

Paper 0009

Gary Housch
Thomas Hucker
Katsuya Chiba
Toshio Murata

International Joint Union Presentation Do Not Blame Responsibilities but Investigate Causes: Roles of Management and Unions Challenging for Railway Safety

Publisher
2000 International Rail Safety Conference

International Rail Safety Conference

Gary Housch, Vice President

Brotherhood of Maintenance Way of Employees, Canada

George Hucker, Vice President

Brotherhood of Locomotive Engineers, Canada

Katsuya Chiba, General Secretary

JREU, Japan

Toshio Murata, Director, Negotiation Dept

JREU, Japan

Do Not Blame Responsibility but Investigate Causes - Roles of Management and Unions Challenging for Railway Safety

Joint Paper

to

The International Railway Safety Conference

London, England

by the

East Japan Railway Workers' Union

Brotherhood of Maintenance of Way Employees

Brotherhood of Locomotive Engineers

Introduction

We, the delegates from the Brotherhood of Maintenance of Way Employees, Brotherhood of Locomotive Engineers and the East Japan Railway Workers' Union, met at the International Railway Safety Conference at Banff, Alberta, Canada, in 1999.

We shared the idea that railway safety was an important issue for Unions. This led to the concept of a joint paper for the London conference. Therefore, this paper, is humbly submitted as a continuation of the International Conference on Railway Safety.

Safety is an essential subject for all of us involved in the Railway Industry. Keeping safe is an eternal subject as accidents result in death or injury to passengers and workers. If we take measures from both sides and utilize technology as a support for human factors we can mitigate much of the danger, but never totally eliminate it. We are constantly being faced with the challenges of unsafe factors impacting on our mutual efforts.

We believe it is meaningful to discuss railway safety from various viewpoints. This paper is an effort to present the basic tenets of safety from the viewpoint of the worker.

As we are from three different countries there are different systems in place. For example accident investigation differs in its method, recommendation, compulsory measures, execution, and so on. The purpose of this paper is not to compare these differences, or point out which country is the best. Notwithstanding our acceptance that investigative practices are different, we present our paper on the premise that we should prevent accidents by learning from concrete examples.

As a matter of course, we started to examine the actual accident cases and preventative measures that resulted. We reviewed these accidents with the idea that we should not look to blame, but rather investigate causes. As Labour Organizations, we included the principle that railway workers at the work site should have input and recommendations for preventative measures.

The discussion and the recommendations we have drawn you may see as lacking. However, we present the opinions that we have shared and we welcome your opinions and questions on this paper.

Japan

Introduction

When a railway accident occurs in Japan, not only the railway company concerned but also many other organizations investigate the causes of accident and take preventive measures.

Among the concerned organizations, the police in particular have very significant powers of investigation. The police are the body with the primary responsibility for inspecting the scene of the accident. Their inspection of the accident scene is immediate and they have the power to charge those presumed responsible and commit them to trial.

On the other hand, the Ministry of Transport has jurisdiction over railway accidents as a government organization. Within the Ministry of Transport there exists a permanent organization called the Accident Analysis Subcommittee whose mandate is to prevent accidents. When a very serious or peculiar accident occurs an Accident Investigation Study Meeting commences. Members of the Accident Analysis Subcommittee and other investigative experts from outside the Subcommittee meet to investigate the cause of accident and discuss preventive measures.

The Study Meeting then reports its conclusions to the railway company concerned. However, the report often takes into consideration the company's financial situation and the recommendations are not binding on the company. The affected company cannot be compelled to follow the conclusion.

However, a tragic subway train accident earlier in this year in Japan, which saw the death of five passengers, may have provided the catalyst for a change in the investigative procedures noted above. In March of this year steps were taken to establish a permanent Railway Accident Investigation Committee within the Ministry of Transport with full investigative authority.

To give some context to the practices and procedures discussed above I will now review two recent railway accidents and discuss the investigative response that followed and the ultimate recommendations and actions that resulted.

Example 1 Japan

On October 12, 1997, in Otuki Station yard on the Chuo line, two trains collided and a large number of passengers and a driver were injured. It appeared that the train driver who drove a shunting electric train did not completely understand his schedule times. He started his train in motion before he confirmed the signal that would indicate that it was safe to proceed. As a result, he committed red signal violation. The shunting train then collided (sideways) with an express on the main track.

However, as ATS (Automatic Train Stop) is installed at this station and on rolling stock as well, the train should have stopped automatically just after the red signal violation. In other words, backup safety equipment was installed to prevent accidents in the event of human error.

Why did not the shunting train stop? At first, the driver of shunting train told his colleague, who was one of our union members, that he had switched off the ATS. However, as the investigation by the police progressed his recollection of the events in question became less clear. Eventually he said, "I do not have clear memory whether I switched it off".

The police conducted an immediate inspection of the accident scene. They interviewed various East Japan Railway managers and employees in addition to the driver. The police began to focus on human error after it was identified that there were no technical defects or ground level abnormalities.

The police interviewed the driver on no less than 14 separate occasions before his arrest and then held him in custody for three days. After his release they interviewed him on an additional 9 occasions.

The district public prosecutor's office prosecuted the driver on 24 December, and a district court sentenced him to imprisonment. However, the sentence was not imposed as a stay of execution was granted on January 2, 1998

Let us now turn to the preventive measures taken by the Ministry of Transport in connection with this incident. The Ministry of Transport cannot perform its own inspections of the scene or investigate the circumstances by hearing from the people directly involved. It is limited to collecting information from the police and requesting an explanation from a company concerned. On the day of the accident The Ministry of Transport issued a "Warning Note" to the East Japan Railway Company. The Ministry's public statement can be paraphrased as follows: "The Ministry of Transport gives a severe warning to East Japan Railway Company. It should draw up a list of preventive measures and take all possible measures to ensure the prevention of similar accidents".

Unfortunately, the Ministry of Transport did not address any of these issues itself as it had, at that time, no responsibility for either investigating causes or drawing up preventive measures. It simply directed the railway company to perform these functions. In response to the Warning Note the East Japan Railway Company offered its explanations several times to the Ministry Of Transport. On April 17, 1998, the Ministry of Transport canceled the license of the train driver who was involved in the accident.

While the investigative authorities were involved in the ways described above, we, the East Japan Railway Workers' Union (JREU) advised the driver to co-operate fully with all investigations and offered our services to assist in representing him. However, he and his family declined our offer of assistance. Possibly, they assumed that any participation from him would only increase his troubles. This placed us in the more difficult position of trying to fairly represent our JREU member and fully investigate the accident at the same time without the benefit of his direct knowledge of the events in question.

Immediately after the accident the JREU started our own investigation in order to establish the real cause of accident. We approached the issue through the following two questions. Why did the driver start the train at Obuki station if there was any lack of clarity concerning the schedule and/or why was the ATS switched off ?

We had frequent discussions with our union members from the local which the driver concerned belonged to and with our managers about work instructions, drivers' education, training and the work environment of the workplace. We focused on the technical issues concerning how the train could have begun to move if the ATS was switched off.

Through the discussion we discovered that the atmosphere at the workplace was not safety-oriented. For example if someone asked questions about workplace procedures and practices he might be fooled by his colleagues and not given a serious response.

We also found out that the ATS system could easily be switched off by the drivers. We always have spoken frankly with our union members and have encouraged efforts to maintain an open workplace atmosphere conducive to the free exchange of information.

As a result of our investigations the East Japan Railway Workers' Union insisted that the company should change the structure of rolling stock, for example, so that the ATS cannot be easily switched off, or so that a train cannot move when the ATS switch is off. We also discovered inadequacies in the training system for drivers.

Now, as a result of negotiation, union and company have agreed on the need to improve vehicle structure and the need to review and improve the drivers' training system in terms of content and frequency. However, it is difficult for us to revolutionize the climate of a workplace. We obtained fruitful results regarding vehicle structures and training systems because these issues can be resolved through the simple investment of money. Unfortunately, workplace climate is not a matter of money but of attitude. From our end, union officers must face union members and propose to reform union members' attitudes and approaches to the culture of safety in the workplace. By improving facilities and equipment, we can improve our results and hopefully prevent similar accidents. However, a human must carry out the work so unless his consciousness can be changed the risk of accidents remains strong.

Conclusions

This accident clearly shows how critical it is for people who are investigating an accident to be provided with accurate and proper information. Unfortunately, but understandably, it is often the case that workers, when faced with possible incarceration and/or loss of employment, will not be overly enthusiastic about being completely open. This is a difficult issue to struggle with. On the one hand, as a union, we must act to protect the interests of workers. On the other hand, we must also take whatever steps are necessary to ensure that every accident is investigated thoroughly and that its cause is definitively established. Of course, these processes are not mutually exclusive and, on a fundamental level, do not conflict. Afterall, nothing serves the interests of a worker more than a safe working environment. For this reason, all necessary preventive measures must be taken to ensure that not only is the cause of an accident determined but that it never reoccurs.

While the accident here under consideration was clearly the result of human error, a deeper analysis of the situation was necessary. Stating than an accident is a result of human error only serves to establish responsibility. It does not necessarily address the root cause of a particular accident. To prevent such accidents from reoccurring, all background factors, including safety equipment and facilities, must be investigated. Such an approach led, in the aftermath of this accident, to the implementation of certain operational changes. These involved making the ATS switch unavailable to the driver as well as to changing the ATS system to a full stop system thereby preventing any train movement.

It goes almost without saying that, for accidents to be properly investigated, a positive relationship must exist between union and management. The JRU is fortunate in that it shares a spirit of cooperation with management insofar as safety issues are concerned. With this spirit of cooperation, union and management worked together to discover the cause of this accident and to take the appropriate preventative action.

The regulatory regime in Japan requires the police and the Ministry of Transport to investigate accidents. However, these investigations seek only to establish culpability. This does nothing to prevent a reoccurrence of the accident, and it often makes investigating the cause much more difficult. Had the JRU and management not addressed the cause in the manner that they did, the only results of this accident investigation would have been that a worker bypassed a safety device and that a worker was to blame for the accident. No real preventative action would have been taken.

Example 2 Japan

On February 21, 1999, between Gotanda and Meguro stations on Yamanote Freight line, a group of contract workers performing signal-communication construction were hit by a deadheading train. Five workers of the group were killed.

The main accident cause appeared to be that a watcher neglected his work and allowed a train to enter the area of construction work while workers were carrying tools and materials.

In addition, there were several background factors in this accident. First, the workers concerned did not have their usual safety meeting prior to commencing work because the supervisor was late for work that day. Second, the fatal train was not a regularly scheduled train and its presence was not expected. Consequently, the supervisor, convinced that there was no train operation, did not call the neighboring station to check on possible train movements and did not tell anything to his men.

The police conducted many interviews with the supervisor after the accident. They also interviewed all other railway staff concerned, including employees of the contract company. As a result, the supervisor and watcher were arrested on 25 June. Both persons were prosecuted by the Tokyo Region Public Prosecutor's Office on 16 July, and on 23 July a fine was assessed to the subcontract company and the watcher. The supervisor received a prison term and after that he was dismissed the company.

As in example #1, the Ministry of Transport issued a "Warning Note" to the East Japan Railway Company within two days of the accident.

In reply to the "Warning" the company submitted several proposed preventative measures concerning the accident to the Ministry of Transport several times but these were simply interim suggestions. On April 2, 1999, after extensive consultation with the JREU, the East Japan Railway Company submitted a report outlining a variety of preventative measures all of which had been discussed and agreed upon by union and management.

What kind of discussion had occurred between union and management? Just after this tragic accident the JREU had insisted upon the suspension of all work in tracks where the primary safety procedure was based upon using intervals of train operation as a temporary evacuation measure.

Afterwards JREU had numerous negotiation sessions with management to create some radical, yet essential, safety measures. It became clear that while establishing clear and enforceable safety rules and regulations was essential sometimes it is not enough. Sometimes more fundamental changes must be considered. Otherwise similar kinds of accident, although outwardly they may appear different, will continue to occur.

The JREU decided to pursue this important subject and we began to talk with management about the more fundamental issues underlying track maintenance work. Quite simply, we asked whether track work should properly be done only by using intervals between train operations.

What we stated was that safety would be maximized if work on tracks was only done by railway track closure.

However, disadvantages of this radical proposal were, at first blush, very significant. Workers would have to work at night when trains did not run. The various characteristics of night shift often reduced workplace efficiency. Additionally, many union members told us, not surprisingly, that they disliked working nightshifts.

However, our internal discussions with officers and members started from the premise that the most important thing for workers was to save our own lives and our co-workers' lives rather than to complete our work on time and finally, after many discussions and debates we built a consensus. As a result of this initiative, the number of railway track closures dramatically increased compared with before. Although it was difficult at first, eventually about 70% of all track, electrical and construction work on the East Japan Railway Company was performed on closed track. Gradually our members have gotten used to working in this way.

However, despite this important change we know that for many of our workers efficient production schedules can be the dominant concern on any worksite. Situations still exist where close adherence to those schedules takes priority over their own safety.

We continue to believe that insofar as far as we cannot reform our members' consciousness and their fundamental awareness of safety issues we cannot adequately protect them. In other words, the mere introduction of safer facilities and equipment and more demanding safety rules and procedures is not enough to prevent accidents. We must continue to engage in efforts to change the very psychology of our membership. Only when safety dominates the mental framework within which they conceive of their own working lives can we truly achieve a safe workplace.

Conclusions

As in our first accident conclusions, the present situation was again one where the regulatory agencies responsible for accident investigation sought only to lay blame. However, the JRU and management were again able to go beyond the mere laying of blame and to work together to find the cause.

In this circumstance, however, the union experienced a greater challenge. The workers involved were not union members but, rather, were the employees of a contractor. The JRU maintained that it was legitimately involved as the accident could just as easily have happened to a JRU member. For this reason, the union felt strongly that it needed to take part in the investigation procedure. At first the company stated that it was not responsible for the accident. However, the JRU insisted that, if not legally, then ethically and morally, the company was obliged to take part in the investigation. The company accepted this position and agreed to investigate the matter jointly with the union.

Again, it would be easy to say that the cause of this accident was simple human error. However, as before, an examination of every consideration was needed. The investigation revealed that two incorrect assumptions were made. First, the supervisor assumed that there was no deadhead train. And second, the watchman assumed that there was no necessity to look for trains until the workers arrived at the work site.

As a result of this joint investigation, the JRU and management agreed that closing (i.e. blocking) a section of track provides maintenance workers with the greatest degree of safety. However, this requires working at night which, in turn, diminishes the workers' quality of life. Nevertheless, the parties felt that the safety of the workers was paramount and established a policy whereby the type of work involved would be performed under the protection of track closures.

It was also determined that there was a need for JR East to offer training to contractors used in the JR facility. It was agreed that revised timetables would be sent to all contractors by JR East whenever schedules were changed. Union and management also jointly developed a manual on proper procedures for JR East and ensured that all contractors received copies thereof.

Was this enough? Perhaps. What we do know, however, is that these new initiatives will produce far safer working environments and, perhaps more importantly, have created a procedure that, rather than simply laying blame, produces truly preventative innovations.

Summary

The police and Ministry of Transport investigate accidents in order to find out who should be blamed because, as institutions, their final aim is to administer judgment. To the extent they seek to modify behaviour it is through the principles of retribution and deterrence.

However, blaming and punishment can never prevent accidents. We can always find some contributing factors from among mechanical faults, defects in work systems or work procedures, the overall environment of the workplace in addition to individual workers' mistakes. Therefore, if they punish a person who made a mistake, they cannot necessarily remove the essential factors that could cause a repeat of the same accident under the same conditions. Of course, it is rare that the person who causes the accident does so intentionally. If the act is intentional it is criminal. However, by definition such acts are not accidental.

Clearly, to achieve meaningful safety we must insist on the necessity of a thorough investigation of all causes. We must analyze all background factors. We can only prevent similar accidents from recurring if we investigate the true nature of all possible causes.

As we have discussed above, in Japan it is the police and the Ministry Of Transport who are officially the main players in accident investigation and the subsequent issuing of preventative measures. However, we believe that as important, if not more so, is frank and thorough discussion between union and management.

Unfortunately, some company managers in Japan still take the approach that companies don't need the union's cooperation on safety issues. They continue to believe that "Managers from headquarters are completely right and those who make mistakes are always the workers at the site.

The JREU believes that union and management need cooperation based an understanding of an equal relationship. Our philosophy is that more important than seeking blame is identifying the true cause of any accident.

We know that each country has own investigation system that may differ in organization, regulation, authorized power, procedure and so on. However, we hope that all share, or come to share, the safety philosophy we have outlined above and continue to strive to put it into practice.

Canada

Rail Safety Regulation

The Canadian *Railway Safety Act*, which came into force in 1989, gave direct jurisdiction over rail safety regulation to the Federal Minister of Transport through the administration of a regulatory body called Transport Canada. The *Act* sets out the Minister's regulatory and rule-making powers regarding the operation and maintenance of railway works and equipment. It also deals with the administration and enforcement of the *Act*, including the appointment of inspectors, the issuing of emergency orders, the performance of medical examinations, and the penalties to be imposed for violations. The *Act* moved the federal government away from a prescriptive to a performance-based regulatory system.

Amendments to the *Act* implemented in 1999 continue to reduce direct Government involvement and to extend the implementation of a performance-based system. For example, an amendment to the *Act* transferred some responsibility from Transport Canada to Railway Safety Management Systems, a System that is designed by each Railway Company and audited by Transport Canada. Other amendments modified procedures to stop whistle-blowing at crossings and to enable the regulation of locomotive emissions. The Government has created a permanent consultative committee involving unions, companies and different levels of government.

The Canada Transportation Act of 1996 enabled the large federally regulated railways to spin-off many of their branch lines to short-line operators operating under provincial jurisdiction. In some provinces, Transport Canada performs the safety monitoring of these short-line railways under contract.

Transport Canada, is responsible for regulating safety in regards to safe railway operations. This is done primarily through a rule making process in which the Minister of Transport may instruct railways to make rules to enhance safety, or by the railways themselves formulating rules for approval by the Minister. During either of these rule making processes, the railways must consult with the unions, and concerns that the unions raise must be forwarded to the Minister of Transport. The Transportation Safety Board, a body responsible for investigating accidents involving operational safety, works at arms-length with the Minister of Transport.

Accident Investigation

The Transportation Safety Board (TSB) is an independent agency created by the *Canadian Transportation Accident Investigation and Safety Board Act* (CTAISB) which came into force on 29 March, 1990. The TSB is independent and free from any conflicts of interest with the regulator (Transport Canada). It investigates accidents, identifies safety deficiencies and makes safety recommendations. Findings and recommendations are publicly available, but in order to provide procedural fairness, persons involved have the opportunity to comment on a draft report. In addition, the railway company involved normally performs an internal investigation of its own.

Basic principles that the TSB follow are:

1) Accident investigation and safety regulation/enforcement are separated to avoid conflict of interest. Where there is a conflict with Transport Canada or other government departments, the TSB prevails.

2) The purpose of the TSB is to make findings as to causes and contributing factors, to identify safety deficiencies and to make recommendations aimed at eliminating deficiencies and improving safety.

3) The purpose of the TSB is not to find fault or apportion blame or liability.

4) Only parties directly involved in an accident are permitted to participate and to review the TSB's draft findings. Workers' organizations such as unions are not granted status to participate.

Injury Investigation Canada

A second regulatory agency relevant for present purposes is known as Labour Canada. Labour Canada is responsible for all "off board" accidents. These are, primarily, workplace accidents that do not involve railway operations. These types of accidents, as well as workplace safety, are covered in a piece of federal legislation entitled the *Canada Labour Code*. Responsibility for the *Code* falls within the jurisdiction of the Federal Minister of Labour.

As with train operation accidents, a railway company, in the context of an "off board" accident, may carry out an internal investigation into the matter. However, the company in question is under no obligation to release its findings. As far as accidents that result in injury are concerned, the *Canada Labour Code* requires health and safety committees to be involved in any investigation held. These committees are composed of both union and management representatives. Until recently, these joint union-management committees have been underutilized. This has been due, at least partly, to a lack of training and expertise on the part of committee members. Recently, however, as a result of improved education and instruction, the joint committees have been functioning more efficiently and appropriately.

In the event of a workplace death, a coroner may also have jurisdiction to be involved. Coroners are medical doctors with special training in pathology. Every Canadian Province is subject to a *Coroner's Act* which establishes a network of regional and local coroners who operate under the supervision of the Chief Coroner. Coroners possess two primary functions: to investigate deaths and, on the basis of the results of such investigations, to make recommendations to promote public safety. Deaths are usually investigated where to do so would "serve the public interest". The format used is that of a Coroner's Inquest.

The Inquest is a formal legal proceeding in which the events leading to the death in question are reviewed in detail before a jury. The coroner may subpoena evidence and any person with a substantial and direct interest may apply for status as a party. Such status gives the interested party the right to examine and cross-examine witnesses and to make submissions. Every Inquest is expected to establish the following: 1) the deceased's identity, 2) when the death occurred, 3) where the death occurred, 4) how the death occurred (the medical cause) and 5) by what means the death occurred (surrounding circumstances). At the conclusion of the Inquest the jury will usually make a number of recommendations designed to prevent similar deaths in the future. The coroner then forwards these recommendations to the appropriate agencies for consideration.

An important characteristic of the Coroner's Inquest is the fact that the jurors are expressly prohibited from making findings of legal responsibility or expressing legal conclusions. The purpose of the Inquest is purely investigative and preventive. It is not a forum for assigning blame or for seeking to establish legal liability.

Canadian Accident involving Railway Operations

On August 12, 1996, CN train 117 collided with 20 uncontrolled cars near mile 122.9 on the Edson Subdivision, near Edson, Alberta. The Engineer and Conductor, as well as one unauthorized passenger, were killed in the collision. Train 117 was traveling at about 54 mph (90 kph) and the runaway cars at about 30 mph (50 kph).

The runaway cars had been left in Edson Yard and two hand brakes on Government Grain Hopper cars had been tied on. The crew leaving these cars in Edson was unsupervised and the performance of the hand brakes on the cars had been found to be highly variable. The derail to prevent the movement of the cars onto the main track had been removed in 1990 (the TSB stated that "this created an unsafe situation that was not detected for over 5 years").

When the cars entered the main track the track circuitry caused bar lights in the Rail Traffic Controller's panel in Edmonton, Alberta to illuminate. However, the Rail Traffic Controller did not notice the lights as he had not been trained to recognize that such lights were consistent with the movement of runaway cars.

Under Transport Canada's 1992 Track Safety Rules, a derail was required at that location (Page 70 TSB report)

Normally, the railway company involved also conducts an investigation into such accidents. In an unusual move, however, and due, in our opinion, to negative publicity, the railway company in this case hired Rail Sciences Inc. of Atlanta, Georgia to conduct an independent reconstruction and engineering analysis of the accident.

Rail Sciences Inc. completed its report by October of 1996. The report found two primary causes of the accident:

1. Insufficient hand brake pressure on the string of cars in Edson Yard; and
2. Failure by the yard crew to perform a mandatory test on those brakes.

Rail Sciences Inc. also found three further contributing factors:

1. The lack of a derail at that location;
2. The lack of an alarm at the Rail Traffic Control Centre for such an occurrence; and
3. The fact that the Controller on duty the night of the accident did not conclude from the unexplained track occupancy signals that an uncontrolled movement of cars was in progress.

On October 4, 1996, CN released the report prepared by Rail Sciences Inc. that publicly laid the blame on the workers. The Globe and Mail (a major Canadian daily newspaper), in a story concerning the accident, proclaimed that "Canadian National Railway workers failed to properly secure a chain of unmanned rail cars that collided with an oncoming freight train in August, killing three men, according to a report released by the Company yesterday. (The report) states that the three men assigned to secure the cars were suspended immediately after the crash and further disciplinary measures are being taken".

However, this was somewhat undermined when, on October 15, 1996, the media reported on a letter dated April 26, 1990, which admitted that the derails were removed in order to save money, and that CN had started replacing the removed derails during the first week of September,1996.

The TSB released its report almost a year later on September 19, 1997. The TSB identified six areas of concern:

1. The effectiveness of procedures involving the number of hand brakes to apply, training and supervision of crews and special considerations for certain locations;
2. The adequacy of the traffic control system for detecting runaways including the ergonomics for controllers, and policies, procedures and training for controllers;
3. The unknown variability of the government hopper car fleet braking system as well as the maintenance of those systems;
4. The adequacy of regulatory overview to determine compliance with national standards by the industry;
5. The effectiveness of company safety management programs regarding the communication of safety related material; and

6. The need for railway companies to institute a policy of strict rule compliance as such is often the only defense against human error.

The TSB only issued two recommendations;

1. To improve employee understanding of the wide variability of hand brake effectiveness; and
2. To improve the regulator's ability to monitor effectively compliance with national standards.

On November 14, 1997, the media again reported on the status of the fired workers. The daily Edmonton Sun stated that " two workers fired after a fatal train wreck near Edson have been reinstated and will be back at work before the end of the year". Another Edmonton daily newspaper, The Journal, stated "the men were fired following the release of a CN commissioned investigation into the 1996 crash....but a Transportation Safety Board report released last September pointed to 'shortcomings' in CN procedures and problems with Transport Canada's enforcement of safety rules as major contributing factors".

Conclusions

We have seen from the Japanese experience how labour/management cooperation can improve safety. We in North America must similarly focus on seeking cause rather than laying blame. Labour and management must work together harder, as equal partners, if safety is to be truly enhanced.

It is clear that, in the accident now under consideration, CN sought to lay blame rather than to address the true causes of the accident. There was a strong reason for the company to ensure that, publicly at least, the workers were blamed. At the time, CN was newly privatized and was open to strong criticisms from the media. To be fair, there is little chance that this would occur today.

During the period following this accident, there was a virtual media frenzy. Someone had to be blamed. First, it was the workers, then the company, then finally by the TSB to the regulator and the company. It is not surprising that during this period there was little cooperation between the parties.

There is almost no doubt that removing the derail in the early 1990's was done solely to enhance productivity. This was done when CN was a Crown Corporation. We will not judge if this was right or wrong, but, rather, will concentrate on what has been done to address the cause of the derailment and to prevent future such occurrences.

Shortly after the derailment, and long before the TSB report, the company had started reinstalling the derails. There is little question that this was a fail safe mechanism for this type of occurrence.

It appears that the TSB had established the cause of the accident and issued only two recommendations. However, no one articulated a method to prevent similar accidents. Some lessons were learned, but they were never clearly acted upon and, as a result, no clear measures were established to prevent reoccurrences.

While we understand that derails have been reinstalled and modifications made to the Rail Traffic Control system, these issues have never been truly analyzed and examined. The question we must ask is "have we ensured that such an accident cannot reoccur and, if so, how?".

Railway Accident involving Personal Injury

Roy Rabe

On June 4, 1992 Mr. Rabe was struck by a locomotive and killed.

Mr. Rabe was an Extra Gang Foreman responsible for a surfacing gang consisting of a Plasser Continuous Action Tamper, a Jackson Tamper, two ballast regulators and a stabilizer. Mr. Rabe held a Track Occupancy Permit("TOP") and was working on the westward track. A train called on the radio wishing to pass using the eastward track. Mr. Rabe instructed the operators to keep clear of fouling the eastward track and then cleared the train to proceed. Mr. Rabe then worked with the stabilizer while standing between the rails of the east track.

The stabilizer, an extremely noisy machine, was operating at full throttle. The stabilizer is also known to be a machine that causes substantial ground vibration. The Locomotive Engineer of the approaching train later stated that he began blowing the train's whistle and ringing the train's bell more that 50 yards away from Mr. Rabe's location. It was noted that, during the performance of his duties, Mr. Rabe was required to use 3 different channels on his radio.

The investigating safety officer found that there were a considerable number of "unwritten policies" involved in the accident. The safety officer found that the primary cause of the accident was the simple fact that Mr. Rabe was standing in the path of the train. However, numerous secondary causes were also revealed:

1. CP Rail's unofficial policies contradicting written ones;
2. Indifference to vigilance at the work site;
3. Attitudes between train crews and maintenance of way gangs;
4. Train speed;
5. Emergency procedures - train crews;
6. Communication between personnel;
7. Too many channels utilized on the radio;
8. Emphasis on factors at the site and not on track speed for the train;
9. Emphasis on implementation of good policies and training left to the whim of regional management;
10. Bad habits allowed to develop under indifference to regional management;
11. Protective equipment - hearing protection;
12. Clearing a train through a TOP before advising employees;
13. Bell and whistle not functioning 200 yards from impact;
14. Failure to use a two-employee Buddy system that could have alerted Mr. Rabe;
15. Track unit radio not functioning - for over one year;
16. Curve - view limited but no change in speed; and
17. Failure to ensure that two employees were assigned to observe the passing train.

As a result, the safety officer recommended:

1. That trains reduce speed through work sites;
2. That the attitudes of track and train workers be improved;
3. That more precise communication, notifying of approaching trains, be utilized;
4. That one radio channel only be used during train passings;

5. That the audibility of locomotive whistles or bells in high noise work locations be improved;
6. That procedures used be similar to those used by controllers;
7. That all unofficial policies contradicting written ones be eliminated;
8. That review procedures for headset radios be implemented;
9. That radio equipment be tested to ensure proper functioning;
10. That emergency procedures be implemented for train crews (e.g. not waiting until last second for horn, bells, brakes etc.);
11. That regional management responsibilities regarding health and safety be reviewed;
12. That an effective buddy system be implemented (fellow employees saw Mr. Rabe walking on track but did not warn him); and
13. That a written policy be prepared dealing with the clearing of trains through work sites.

There was also a Coroner's Inquest into this accident. The Jury found and suggested that:

1. Train speed be reduced through work sites;
2. Communications between rolling stock personnel and maintenance of way personnel be more precise (example would be the number of workers in site, the number of machines, size of work area, etc.);
3. For radio communications during the passing of a train, only one channel be scanned;
4. A more effective warning system be developed for high noise level work sites;
5. All "unofficial policies" that contradict working policies on occupational health and safety be eliminated;
6. Requirements for protective clothing and equipment be increased (for example, the use of neon coloured vests, headsets, etc.);
7. The quality of equipment inspection prior to leaving a rail yard be improved (for example, the radio on track unit);
8. Regional management responsibility for health and safety issues be reviewed, and Health and Safety issues be evaluated in managers' job performance;
9. The Foreman or Supervisor responsible for a TOP be required to obtain confirmation from the work crew that they are aware of approaching trains prior to their being cleared through the TOP;
10. Health and Safety programs be the joint responsibility of management and labour. That all safety audits be conducted jointly and that such audits be distributed widely. As well, a reasonable deadline for when action is to be taken should be imposed; and
11. Safety meetings be mandatory and that those present be required to acknowledge formally their attendance.

Conclusions

It is unfortunate that it had to take a precious life to learn the many lessons that we have from this tragic accident.

There is a strong desire in the industry around the world for workers to be productive and to "get the job done". This climate in the workplace is something that all Health and Safety advocates must be made aware of. This climate exists not just in management but also with workers. This is the climate that led to the "unwritten policies" referred to by the safety officer. There were clear unambiguous rules that were violated in this circumstance. However, there was also an unwritten policy to ignore the rules, in order to be more productive. Only joint action by both union and company officers at all levels can change this attitude.

As a union, we feel that much of this was caused by poorly trained joint health and safety committees at the worksite. The accident acted as a drastic wake up call to both union and management. As a result, the situation has been very aggressively addressed.

This accident is an example of the basic principle that strict rule compliance is the only real protection against human error. Our discussions with our dear friends from Japan have made us realize that simply writing another rule or ensuring training in rules cannot, in and of themselves, provide the entire solution. Attitudes must change Both management and workers must realize that rules, after they are written, must be followed. In this regard, we must always ask ourselves what more we can we do to support and to educate workers to help make their working conditions safer.

For example, JR East has a system that automatically announces the approach of a train. In North America we have hot box detectors that automatically radio a train to announce its findings. Surely this technology can be adapted to alert personnel to the approach of a train. This would ensure strict compliance with the rules and would support and protect individuals working on or near tracks.

United States of America

Regulation and Accident Investigation

There is a similar approach to railway safety and accident investigation in the U.S.

The U.S. Department of Transportation Federal Railroad Administration (FRA) has responsibility for setting railway safety standards and enforcing them. As in Canada, the regulator has moved to more of a focus on results. The Safety Assurance and Compliance Program (SACP) complements the traditional enforcement program with an approach that seeks to identify and to correct underlying problems. Federal railroad safety legislation is set out in Chapter 51 and Chapters 201, 203, 205, 207, 209, 211 and 213 of the U.S. Code.

The Surface Transportation Board (STB) reviews safety problems that may be created by mergers or acquisitions, and can require merging railroads to take steps to mitigate problems that are anticipated.

The U.S. National Transportation Safety Board was created in 1967 to conduct independent investigations into all civil aviation accidents as well as major accidents in other modes of transportation including rail. As in Canada, the Board is separate from the Department of Transportation and has no regulatory powers. Its emphasis is on making safety recommendations and not on the assignment of blame assigning blame or liability. In fact, the Board's analysis of information and determination of probable cause cannot be entered as evidence in court of law.

Accident involving Railway Operations

On July 31, 1991, at approximately 5:01AM, train #82, called the Silver Star, was en route from Tampa, Florida to New York City. The train was operating over CSX Transportation Inc. ("CSXT") main line when it derailed at mile 329.6 of the Hamlet Subdivision at Lugoff, South Carolina.

There were 407 people on the train including 16 on board personnel and six operating crew members. As a result of the derailment, minor injuries were reported by 75 passengers and 12 crew members. Three passengers sustained serious injuries. Eight passengers died.

The train was operating at the maximum allowable speed of 79 miles per hour when it approached the switch at Lugoff siding. The two locomotives, and the first 12 of the train's 18 cars, passed the point of derailment. Unfortunately, the following six cars derailed. These derailed cars struck several hopper cars on an adjacent siding causing the first two hopper cars to derail. The standing hopper cars split open the sides of the last three passenger cars.

After the train stopped, the locomotive engineer attempted to contact the CSXT dispatcher in Jacksonville, Florida. According to the relevant log, the dispatcher received an emergency tone at 5:04AM to which the dispatcher responded. However, the engineer could not hear the response as the transmitter board at the Lugoff base station was defective. After several minutes there was another attempt to contact the dispatcher from the second locomotive. Again the dispatcher responded but could not be heard. At 5:08AM the engineer successfully contacted Cayce Yard personnel who acknowledged the message and contacted the Richland County emergency operator. The dispatcher monitored this conversation and heard the engineer give his location as "the Lugoff crossover". At 5:12AM, the assistant chief dispatcher contacted the Kershaw County Emergency Medical Services, advised them of the accident, and stated that the train was between Lugoff and Camden Also at about 5:12AM, the engineer called Cayce Yard again and gave a more explicit location "at the crossover into the Dupont plant at Lugoff". The Kershaw County Sheriff's Department located the train at 5:24AM.

The main track switch at this location had a 51-A New Century Bethlehem switch stand which had a metal safety plate underneath which was installed in 1962. This safety plate had been designed by CSXT and manufactured by the Bethlehem Steel Corporation.

According to inspection records, this switch had been inspected 55 times in the 3 month period preceding the accident. The last annual switch inspection had been carried out on October 26, 1990. The switch was not disassembled as was required by CSXT rules, and no conditions requiring repair were noted. The Roadmaster and Inspector observed that the crib between the ties was full of ballast but had not done anything to remove any ballast. Ballast in this crib area could adversely affect the movement of the switch components.

When examining this switch immediately after the accident it was found that the connecting rod was not connected to the crank. It was determined that the cross pin that retains the crank onto the spindle was not in place. This allowed the crank to fall to the safety plate. There were marks on the safety plate that indicated the crank had been moved while in contact with the plate. Post accident assembly indicated that with a cross pin in place the crank was the proper distance from the safety plate. A 1 ¼ inch piece of the cross pin was found buried in about 3 inches of ballast and a two inch piece on top of the ballast below the switch stand.

It was found that, under load, there was a cross level error of 15/16 inches over the area of the derailment. Federal Railroad Administration ("FRA") standards allow for 1¼ inches.

The National Transportation Safety Board ("NTSB") found that "despite the missing cross pin, the switch operated for a period of time before the accident, as demonstrated by the rub marks on the safety plate caused by rotational contact with the crank", and "The irregular track surface and the normal motion of the track structure and the switch from the passage of the train caused the inadequately connected connecting rod and crank to separate". The board also concluded that the cross pin had been missing for some time due to corrosion and the location of one piece under 3 inches of ballast.

The Board also found that the inspections and maintenance of this switch were inadequate and that the switch "had required or received maintenance as a result of either damage or excessive wear" and that "if the switch had been maintained to comply with the CSXT and FRA requirements, such as the requirement that the connecting rod must be securely fastened the worn, broken, fouled, and missing parts would have been noted and corrected and the accident would probably not have occurred".

Both the Brotherhood of Maintenance of Way Employees and the Brotherhood of Locomotive Engineers made depositions to the NTSB on November 7 and 8, 1991. Concerns were raised over the 50% reduction in manpower in the previous 11 years.

The NTSB found that there was not sufficient time for the Inspector to fulfill his inspection requirements. Testimony of the Inspector indicated that there was not sufficient time to carry out his inspections while also being responsible for maintenance and other duties. He advised that this had been the case for about 4 years, and attributed the situation to the elimination of some positions and the reassignment of personnel.

Although the roadmaster reported working 10 to 11 hours per day he could not complete 50% of inspections for which he was responsible. Reports for the three month period preceding the accident indicated that he had completed only 4 of 55 (7%) inspections. This resulted in the inspector having his number of inspections increased when there was already more work than he could manage.

The NTSB listed their findings:

1. The train operation, the signal system, the weather, the design of the switch stand, and the passenger train equipment were not factors in the accident.
2. The switch stand cross pin had fractured and been missing from the spindle and crank for some time before the accident.
3. The CSXT track maintenance and inspection process was not adequate to detect and correct in a timely manner the problem that existed in the Orlon crossover switch.
4. The Orlon crossover switch was not properly maintained for some time before the accident.
5. The on-board service crewmembers failed to follow appropriate established emergency procedures, such as using the public address system to inform passengers about the emergency and give related instructions.
6. The on-board service crewmembers were not required to attend periodic training in first aid or emergency procedures, such as the use of the public address system to locate passengers who had medical expertise and might have been able to render assistance.
7. Had new instructions on emergency radio procedures been published in the CSXT timetable, the locomotive crew might have broadcast a more detailed description of the train location and eliminated the confusion and delay.
8. The inability of the dispatcher to respond over the Lugoff base radio station because of the transmitter board failure slowed the emergency response effort.
9. The post accident drug and alcohol testing was not conducted soon enough after the accident to provide meaningful test results.

The NTSB recommended:

- to CSXT:

Review and revise, as necessary, existing practices to ensure that track supervisors review their subordinates' track inspections and that switch inspections are adequately documented.

Review and revise, as necessary, manpower schedules for track and switch inspections to ensure that the track and switch standards of both the FRA and CSXT can be met.

Instruct dispatchers on the use of terminology that can be readily understood by local emergency personnel when advising them of train locations after an accident.

Revise post accident drug and alcohol testing procedures to ensure timely specimen collection.

- to the National Railroad Passenger Corporation:

Require that all on-board service personnel periodically take training in the emergency operating rules and in first aid, cardiopulmonary resuscitation, and the use of the public address system during train emergencies

Conclusions

It is clear that the Union involvement in the depositions conducted by the NTSB was critical to the findings of this investigation. This involvement led to the conclusion that there was a lack of workers to properly conduct the switch inspections. Union involvement in these depositions also helped establish the information required by engineer to properly notify train dispatchers of train location

We feel it is incumbent to comment on the post accident drug and alcohol testing requirement in the U.S.A.. Testing crew members under circumstances such as this accident could serve to fix blame in an area that was not truly a factor in the accident and may, we submit, serve to change the focus of the investigation. Indeed the NTSB, in recommendation number 9 raised the concern over the length of time between the accident and the time testing was conducted.

We submit that there are a few questions that remain unanswered as a result of this matter:

1. The issue of a faulty radio circuit board which was unknown to the dispatcher.
2. The age of the equipment is an issue that is not dealt with. It had been 38 years since the safety plate was installed.
3. There was a large gap in the true job requrements and the time allotted for such work. In this instance more supervisions did not address the issue nor was this issue properly addressed in the recommendations.

Recommendations of this Paper

1. Not to seek blame but, rather, to investigate causes including background causes.
2. To accept that humans make mistakes. Simply seeking to lay blame does little to prevent the reoccurrence of an accident. Both management and workers must recognize and accept this basic truth.
3. To ensure that every investigative process is open and transparent, and to allow for participation from anyone with an interest or an expertise in the area.
4. To ensure that every party to an investigation has equal standing and is treated as an equal.
5. To ensure that persons involved in accidents are not at risk of job loss or incarceration. Such a threat only serves to alienate the parties and to make the determination of root causes more difficult. That being said, it is not our intent to remove the concept of responsibility entirely from the investigation.
6. To encourage the use of technology to back up workers and ensure a safer working environment.

International Rail Safety Conference

2000 LONDON

8 November - 10 November 2000
Forum Hotel, London, United Kingdom

Paper 0010

Dr Debbie Lucas (Chair)

First Plenary Session
Issues surrounding the Human Factor and Railway Safety

Note: Paper 0009 formed the keynote discussion paper for this Plenary Session. As the session was conducted as an interactive verbal discussion, no written paper is available of the outcome of these discussions.

Publisher
2000 International Rail Safety Conference

International Rail Safety Conference

2000 LONDON

8 November - 10 November 2000
Forum Hotel, London, United Kingdom

Paper 0011

Dr Francine Keravel

Level Crossings: Technical Choice based on Car-Driver Behaviour

Publisher
2000 International Rail Safety Conference

International Rail Safety Conference

Dr Francine Keravel

Benchmarking & Reliability Advisor

Reseau Ferre de France

Level Crossings: Technical Choice Based on Car-Driver Behaviour

RESEAU
FERRE DE
FRANCE

Road and railway interface safety: Level crossing and road users behaviour.

Francine KERAVEL
Réseau Ferré de France
Tour Pascal A, 6, Place des Degrés, 92045 - Paris La Défense Cedex, France
Tel.: 33 (0) 1.46.96.91.10 Fax: 33 (0) 1 46.96.90.81
e-mail: francine.keravel@rff.fr

Summary

Réseau Ferré de France, which is the manager of French railway network, has to foster modernization of the railway system in order to respond more effectively to customer and public's expectations and safety requirement. RFF assets include 80 000 hectares of land, 32 000 km of tracks, 19 700 level crossings, 38 428 engineering structures, and the buildings devoted to operation and maintenance of the infrastructure.

Railway safety improvement has to be considered as a global system integrating functional needs especially at the major interface point, the level crossing between road and rail, with the environment and human factors.
Whenever an accident happens on a level crossing, it appears as a railway accident. In fact, the road users behaviour has the main impact upon risk assessment.

The qualitative analysis of events gives a better understanding of risk and dangerous factors with:
- Risk perception by each kind of user, the research of dangerous factors non-perception,
- Risk links with common meaning of danger reference point,
- And for each user, making an inventory of possible improvement, from preventive to regulation and rules compulsary, from alarm to allowed error, until direct action upon vehicle and legal action.

Taking into account road users behaviour, new technologies and adequate improvements can be performed.

Keywords
Level crossing, road-users behaviour, functional traffic interface, risk assessment, signalling, regulations, safety improvement, system analysis.

Réseau Ferré de France was founded at the beginning of 1997 to respond to three closely inter-related concerns vital for the railway future :

- to clarify responsibilities between the state and SNCF – especially regarding infrastructure – within the context of the public service role
- to enable a railway system on the verge of paralysis to regain a sound financial footing
- to foster modernisation of the railway system in order to respond more effectively to customer's and society's expectations.

RFF is a public entity of an industrial and commercial character. It is administered by a Board of Directors which has seven State representatives, five people chosen for their experience, and two elected representatives of employees.

RFF is subject to state economic, financial and technical control. Administrative and technical control is undertaken by the department of the minister of transports. Economic and financial control is undertaken by a dedicated team of controllers on behalf of the ministers for the Economy and the Budget.

To fulfil its mission, RFF :

- receives track access fees: a regulatory ceiling has been set at a level of FRF 10 bn for 2000. RFF is preparing the infrastructure pricing system for the following years,
- receives financial support from the State, local authorities and European Community organisations, in the form of contribution to infrastructure costs, capital endowments or investment subsidies.
- capitalises its property
- has been introduced into capital markets as a new and regular issuer.

RFF must be strict in its own financial.

. RFF assets include 80 000 hectares of land, 32 000 km of tracks, 19 700 level crossings, 38 428 engineering structures, and the buildings devoted to operation and maintenance of the infrastructure.

Road and railway interface safety is one of the focused target for RFF.

At the beginning of railways, traffic on roads was not a problem and it was obvious that road users had to stop when crossing a train. But, as early as the 1920s, the important growth of road traffic led the authorities to get aware of the danger of creating new level crossings between roads and railways. Then their creation was seriously challenged.

Nevertheless, in 1938, when the national company of French railways was created, there were 33.500 public level crossings for cars and pedestrians in France. As today there are still about 18.000 level crossings on French railway network, their safety is an important concern for Réseau Ferré de France, which is the new manager of this network.

Whenever an accident happens on a level crossing, it appears as a railway accident, even if the responsibility of the accident relies on the road-user.

In fact, road and railway managers have a big challenge to take up together: how can we improve level crossing safety?

Level crossing safety : some observations

Even an accident occurs, investments are decided relevant with regulations and technical means, but not really with a deeply understanding of road users behaviour.

When road and railway flows meet together, safety rests essentially on signalling respect as planned by regulations in order to oblige motorists to conform to the absolute priority of trains due to their braking performances.

Since level crossings exist, their automation has been one of the most important technical improvements to increase safety by restricting human failing risks. Today in France, more than 11.000 level crossings among 18.000 are automatically operated

The analysis of main level crossing accident reasons highlights the importance of road-users irregular behaviour, as well as defects due to infrastructures. An insufficient perception of level crossing or an unsuitable site layout are frequently involved.

Among road-users reprehensible behaviours, we must note particularly bypassing automatic barriers at level crossings with 2 half-barriers, non-respect of stop obligation when signalling imposes it (flashing red light or stop sign), collisions with and breaking down of barriers (particularly while they are closing) and at last excessive approaching speeds

Every time it is technically and financially possible, and whenever the interest is proved according to the real risks, the elimination of a level crossing is the best choice for safety. However, according to the number of existing level crossings and to the cost of necessary investments, these eliminations will still remain insufficient to improve safety.

When it was considered appropriate to do so, regulations relating to level crossings regularly evolved, in order to take into account possible improvements. Since 1979, road regulations have been improved so that an absolute observance of Highway Code by road-users will never lead to a dangerous situation.

Reflections and studies are going on constantly between relevant bodies in order to try to improve safety with the help of rules.

A national policy for level crossing safety improvement has been decided.

Following a serious level crossing accident which caused the death of 13 persons in a railcar on September 8th 1997, the minister of equipment, transports and housing decided to implement a strong action of level crossing safety improvement in France, since the very beginning of 1998. In order to operate it, a co-ordination authority of this national policy has been created gathering road and railways managers together with concerned central civil service authorities.

A level crossings elimination and improvement programme has been launched in 1998. With an important financial funding, this programme consists in the elimination of the most preoccupying level crossings as soon as it is possible and in an improvement of the announcing and road signalling systems as well as minor equipment for a great number of level crossings

A programme of studies, researches and experiments has been developed too. This programme will be exemplary as it brings all services and bodies responsible in the field of level crossing safety improvement to be partners, and it should create a strong dynamism and obtain approval of all the involved parties.

Réseau Ferré de France (RFF) is in charge, together with French National Railways (SNCF), of deciding the priorities according to safety and implementing this programme
It consists of 3 phases.

Phase 1 – State of the situation

- **Analysis of international regulations relating to traffic and signalling**

The purpose of this study is to compare the situation of level crossings in France with other European networks such as UK, Belgium, the Netherlands, Germany, Italy, Spain, Portugal and Sweden, as well as Japan and the United States, in order to analyse their approach of these problems and to enrich the potential of ideas likely to improve safety. Following the interest from different countries government experts for this study, it has been decided to create an informal working group at European level with a view to exchange national experiences on this subject.

- **Inventory of level crossings : creation of a shared data bank**

In front of the diversity of road and railways managers in France, the need to create a shared referential of all of level crossings appeared as an evidence in order to allow a better knowledge of level crossings' patrimony and to define together priorities for the treatment of problematic situations.

To be aware of the level crossing "estate" on the territory as well as of a number of relevant data about traffic and safety, giving an accurate account of the situation and the stakes, to have a reliable data base for studies, improvements and experiments on relevant level crossings, a joint data processing system is getting realised in common with both railway and road managers.

- **Situation of experiments in hand**

An inventory of all methods, experiments or initiatives (alteration of the normal installations of a level crossing) presently in hand will allow a better rationalisation of experiments conducted by the various route managers and to draw lessons from them from now on.

Phase 2 : studies and researches

- **Diagnosis on dangerous level crossings' safety**

This study will allow a better knowledge of level crossing accident processes, in order to identify typical accident scenarios and discrimination factors. On a selection of relevant level crossings, a detailed analysis of several accidents is getting realised, with the help of available specific surveys.

- **Analysis of road-users behaviour at level crossings**

Video camera recordings of road-users behaviour at level crossings, before and after equipment modifications, in particular modifications of signalling, let push forward abnormal driving attitudes and risky comportment the analysis of which should lead to guide researches.

- **Research for a model of correlation between incidents at level crossings (broken barriers, accidents, ...) and traffic and infrastructure indicators by site typology**

From the future shared level crossings' data bank, a method will be finalised to build a model for the prediction of accidents (even of nearly-accidents) according to different traffic and infrastructure variables by site typology.

- **Finalisation of a scale to analyse level crossing infrastructure**

After the completion of the diagnosis on dangerous level crossings' safety, a checklist of level crossing safety for each kind of line and level crossing will let us identify potentially dangerous level crossings, then determine a typology of corrective measures and evaluate their costs.

- **Macro-economic analysis of an improvement programme**

The aim of this action is to draw up different scenarios for level crossing safety improvement schedules, according to a cost-effectiveness analysis.

Phase 3 :

- **Level crossing functional analysis**

The use of the functional analysis method is intended to define the functionalities expected from a level crossing, to propose the experiment of signalling equipment and specific fitting and to take an inventory and evaluate the contribution of available new technologies to meet these functionalities according to their relative importance defined through value analysis.

- **Analysis of the level crossing from the regulations and laws points of view**

This survey, based on regulations and legal arguments, is realised through legal units of central civil service authorities in order to analyse the regulation and legal nature of a level crossing while identifying basic texts.

- **Definition of a protocol for experiments, with valuation of these experiments and of new technologies**

From industrialists' proposals and given the results of level crossing functional analysis, a protocol for experiments and valuation will be written to precisely define the scope of future experiments.

The expected purposes from new experiments rely on global systems set up to reinforce level crossing safety through one or more actions aimed at mobiles (road users and/or trains).

The sought-after system will have to be developed for both road and railway fields according to the main following axis:

- the detection of a dangerous situation,
- the processing and the development of an alert information,
- the transmission of the alert information,
- the warning, the alarm to users.

Detection of a dangerous situation

The detection of an identified obstacle or of the potentiality of happening of an obstacle should be the subject of experiments with the help of GPS, radar, video signal, laser scanning, infrared rays, etc.

Processing and development of an alert information

Data received from detection sub-system will be processed in order to elaborate a binary alert information intended for road-users and/or trains, while getting near a level crossing.

Transmission of the alert information

The transmission of the alert information to motorist and/or trains with the aim of warning or stopping or slowing down, can be tested through a balise (sign) based train speed control (French ATP = KVB), a GSM system, etc.

Warning and/or stopping of road users (or even of an approaching train)

The alert information is used by different technical devices, which will either give a shape to a coming danger or give an order of stopping. Thus anti-incursion devices will be tested on the road at the same time as emergency braking devices for trains.

The furthest working features will be tested. For all experimented systems, expected availability rates will be evaluated, a safety functional analysis will bring a critical survey of external specifications as far as sturdiness, availability/safety and rubble and incompatibility are concerned. At last a risks analysis will be realised in the field of project safety engineering.

The Road-users behaviour proved to be a real safety improvement.

The analysis of main level crossing accident reasons highlights the importance of road-users irregular behaviour, as well as defects due to infrastructures (insufficient perception of level crossing or unsuitable site layout).
Among road-users reprehensible behaviours, we must note particularly bypassing automatic barriers at level crossings with 2 half-barriers, non-respect of stop obligation when signalling imposes it (flashing red light or stop sign), collisions with and breaking down of barriers (particularly while they are closing) and at last excessive approaching speeds

One of the main accident reasons is an excessive road-users speed while approaching level crossings. Experiments are still conducted to improve the perception of level crossings in their environment.

Shortcomings due to infrastructures have been pointed out as another one of the main causes of level crossing accidents. Measures are taken to improve level crossings' visibility and legibility as well as their suitability to vehicles dynamic constraints.

At last, physical measures appropriate to reduce a lot vehicles' speed near level crossings are strongly recommended.

The target of such experiments :

As the experimentations conducted before, lacked rigour and legibility, the targets are clearly established :

- to better understand the users behaviour in approach of level crossing and the deviated skill and rules relevant the visual information,
  . to observe and to understand this deviation and to experiment new signalling information to announce a level crossing,
  . to emphasize the necessity for the drivers, to have a conscience of danger and respect the road information,

- to estimate the reliability of shape detectors on field by using new technologies and the input for safety user of level crossing,

- to analyse the improvement of driver behaviour and deduce the better choice of investments as median line, moving visual signpost, central low wall, reinforced barriers, portico, brilliance headlights, alert headlights.

The innovation concerns :
- a deeply analyse of drivers behaviour approaching the level crossing and going through,
- the choice of new technologies to detect and appreciate the potential gravity of the situation.

The analyse considers successively :
- The over speed and car approaching,
- The drive skill through trajectory and deceleration by respect of signs,
- The queues,
- The ascent queues from downstream of level crossing,
- The immobilizations of vehicles on level crossing

Conclusion

Besides an essential level crossing safety increase which is the very first ambition, the implementation of new technologies making safer level crossing intersections between road and railways flows should also allow to save investments to suppress level crossings thanks to a better reliability.

Road and railway managers have a big challenge to take up together to improve level crossing safety.

With the help of new technologies, a new era can begin to help this purpose. A set of actions is starting up to benefit from these new technologies to develop a new approach of safety improvement for these key issues.

International Rail Safety Conference

2000 LONDON

8 November - 10 November 2000
Forum Hotel, London, United Kingdom

Paper 0012

Ms Kirsi Pajunen

Countermeasures to Improve Safety at Railway Level Crossings

Publisher
2000 International Rail Safety Conference

International Rail Safety Conference

Kirsi Pajunen

VTT Communities & Infrastructure, Finland

Countermeasures to Improve Safety at Railway Level Crossings

COUNTERMEASURES TO IMPROVE TRAFFIC SAFETY AT RAILWAY LEVEL CROSSINGS

Kirsi Pajunen
VTT Communities and Infrastructure, Transport and Urban Planning
kirsi.pajunen@vtt.fi

INTRODUCTION

This presentation is based on research written in Finnish and with an English abstract:

Pajunen, K & Katajisto, P. Rautatietasoristeysten turvaaminen. (Countermeasures to improve traffic safety at railway level crossings). Technical Research Centre of Finland, Communities and Infrastructure. Research report 543/2000.

In the research we described the problem of traffic safety at railroad level crossings. We also listed almost one hundred different countermeasures to improve traffic safety at railroad level crossings. The pros and cons of the countermeasures and their applicability to the conditions in Finland were assessed. The identification of countermeasures was based mainly on literature review and interviews of experts.

Finnish Rail Administration has also started to monitor all railway level crossings on their rails. The monitoring has already been made on some rail sections (a few hundred railway level crossings have been monitored) and will continue for some years. The results show that the most common problem is insufficient sight distances. Also the gradients of the road and waiting landing are often not according the regulations. We made recommendations for countermeasures to improve traffic safety at monitored railway level crossings. They were classified to be carried out immediately, soon or later. The countermeasures to be carried out immediately were e.g. speed limits for trains or clearing the vegetation to improve sight distances. A countermeasure to be carried out soon (within a year) could be e.g. equipping the level crossing with half-barriers and later e.g. building of grade separated crossing or a new road connection. A computer program called ARC (Audit of Railway level Crossings) can view all monitored railway level crossings.

BACKGROUND

The crashes at railway level crossings represent a significant part of casualties in railway traffic. Having two different traffic modes meeting each other at level is always a challenge for traffic safety. Legally the train has always right-of-way at railway level crossings in all countries. Because the car driver has to give way it is very easily assumed that the car driver is also the only responsible party for the crash.

On the network of Finnish Rail Administration there were about 4300 railway level crossings at the beginning of year 2000. About 500 of those were the crossings with the public road and a little less than 300 crossings with streets. In addition there were about 900 railway level crossings on the private rails *(table 1)*.

Table 1. Information on Finnish rail network and railway level crossings.

Total length of railway lines	5 836 km
Total track length including sidings	8 680 km
Gauge	1 524 mm
Lines with two or more tracks	507 km
Electrified line	2 234 km
Tunnels	42
Total length of tunnels	25 284 m
Number of level crossings on main line	3 554
Number of level crossings on whole rail network	5210
Half-barriers	806
Crashes at railway level crossings during 1999	48
Fatalities at railway level crossings during 1999	10

About 56% of train traffic accidents and 56% of resulting fatalities in Finland occur at railroad level crossings. Improving the traffic safety of railroad level crossings is therefore an important issue when improving safety of train traffic. The crashes at railroad level crossings are more severe than road traffic crashes on average. For avoiding those crashes it is important that the road user is aware that she or he is approaching the railroad level crossing.

In Finland and also in other countries both the absolute numbers of crashes at railway level crossings and crashes per number of railroad level crossings were decreasing from 1970's to 1990's. In Finland the decrease slowed down during the second half of 1990's.

The number of accidents at railway level crossings in Europe, USA and Japan was compared. In the USA the number of railway level crossings per rail-kilometre is very low *(table 2)* and in Japan the number is high. (Godziejewski et al. 1999)

The number of crashes per railway level crossing was lowest in Norway and highest in Czech republic, where the number of fatalities per railway level cross-

ing was also the highest. In Norway one of the factors effecting to the low number of crashes per railway level crossing is that every railway level crossing is equipped with some kind of safety device.
The traffic safety at railway level crossings is on higher level in Sweden and Norway than in Finland. In Sweden they have high volume of railway level crossings per rail-kilometre but have a low number of crashes and the lowest number of fatalities per railway level crossing. The Swedish have paid special attention and allocated resources for improving the traffic safety at railway level crossings. They have very clear criteria for selecting the proper warning device to different types of railroad level crossings. The criteria seem to be very strict compared to the present status of warning devices in Finland and the conditions are tightened frequently.

Table 2. The number of railway level crossings per rail-kilometres and the number of crashes and fatalities per 100 railway level crossings in Europe, Japan and USA. (Godziejewski et al., 1999, Banverket, Jernbaneverket, Finnish Rail Administration)

Country	**Railway level crossings/km**	**Crashes/ 100 railway level crossings**	**Fatalities/ 100 railway level crossings**
Japan	1,41	1,28	0,34
USA	0,10	1,35	0,17
Germany	0,73	1,73	0,35
France	0,66	1,10	0,24
Poland	0,73	0,96	0,51
Sweden	0,88	0,28	0,08
UK	0,56	0,39	0,24
Czech rep.	0,90	2,93	0,84
Italy	0,46	0,48	0,13
Norway	1,26	0,24	0,12
Finland	0,74	1,12	0,23
Mean	*0,77*	*1,08*	*0,30*

In Finland the number of railway level crossings per rail kilometre and crashes per railway level crossings are very near the average. We have a little more fatalities per railway level crossing than the countries of the table in average.

It is very difficult to make international comparisons on railway safety. The data are collected by UIC, but the data from one country can represent only one operator. Comparisons between countries are therefore almost impossible to make based on that data. There is also very limited and out of date information on accidents, fatalities and person injuries.

COUNTERMEASURES TO IMPROVE TRAFFIC SAFETY

All the countermeasures and their sub-measures listed in the research and the types of railway level crossings they can be applied are listed in table 3.

Table 3. Countermeasures to improve traffic safety at railway level crossings. (In the table level crossing = railway level crossing.)

Countermeasure	**Sub-measure**	**Applicability**
Closing of level crossing		Level crossing not in use
Replacing with a new road connection		Private road with low traffic volume or high-speed trains
Combining several level crossings		Private road with low traffic volume or high-speed trains
Closing of level crossing partly (pedestrians and bicycles allowed)		Replacing road connection exists, pedestrian and bicycle volumes high
Whole barriers		Pedestrians and bicycles
	Breakable materials	All barriers
	Fault diagnosis	Automatic barriers
	Room for bypass	Whole barriers
Four-quadrant gates		Road traffic volume high
Half-barriers		Road traffic volume high
	Extension of half-barriers	All half-barriers
	Breakable materials	All barriers
	Reflecting materials	All barriers
	Nets to half-barriers (looks like a gate)	All half-barriers
	Fault diagnosis	Automatic barriers
	Automatic obstacle detection	Information to train, new techniques in use
	Timing according to the speed of the train	New techniques in use
	Blinking light also on the barrier	Automatic barriers
	Optimisation of location	All barriers
	Fence in the middle of the road	Road has more than two lanes
	Other activities during the waiting time	New techniques in use
	Indicator for the direction the train is coming from	New techniques in use
Flashers and warning bells		Moderate road traffic
	Optimisation of location	All warning device
	Strobe lights	Flashers & warning bells or half-barriers
	LED's	The visibility of flashers poor

Countermeasure	Sub-measure	Applicability
	Fault diagnosis	New techniques in use
	Optimisation of timing	New techniques in use
	Timing according to the speed of the train	New techniques in use
	Advance warning with signals	Level crossing difficult to perceive
	Other activities during the waiting time	New techniques in use
	Indicator for the direction the train is coming from	New techniques in use
Warning bells	Voice to the direction of the road	Urban areas
Warning signal for one domain (ägovägslampa)		Road leading only to one domain
'Level crossing signal'		Level crossings of private roads
Straightening of road		Some private roads, investigation needed
Gradient of road according to regulations		Level crossings of private roads
Reconditioning of waiting landings		Level crossings of private roads
	Gradient	Level crossings of private roads
	Length of waiting landings	All level crossings
Grating on the road before the level crossing		Unpaved roads, level crossing difficult to perceive
Humps on the road before the level crossing		Paved road, Level crossing difficult to perceive
Optimisation of deck material		All level crossings
Paving of road near the level crossing		Unpaved roads, moderate road traffic volumes
Improving the sight distances		Level crossings with short sight distances
	Clearing of vegetation	Vegetation obstructing the sight
	Removing of waste after construction	Rudiments obstructing the sight
	Removing of buildings	Buildings that are possible to move or demolish obstructing the sight
	Reconditioning of climbing restraints	Climbing restraints obstructing the sight
	Staking of sight distance areas on the ground	All level crossings
Intensifying of maintenance		All level crossings
	During summer: filling up the holes	Level crossings of private roads

Countermeasure	Sub-measure	Applicability
	During winter: timing of ploughing	Level crossings of public roads
	Sand boxes at level crossings	Gradient of road is high before the level crossing
	Condition of decks	Decks need reconditioning
Pedestrians and bicycles meandering across the rail		Level crossings for pedestrians and bicycles only
Periodic closing of level crossing		Private roads with low traffic volumes
Prohibiting the driving across the rail with long vehicles (trucks)		Sight distances poor or gradient of the road high
Equipping the level crossing with barriers with locks		Only one or few users at the level crossing
Asking permission to cross the rail by phone		Private roads with low traffic volumes
Warning signs before the level crossing		All level crossings
	Checking the location	All level crossings
	Correct signs	All level crossings
	Sign of the angle between road and rail	Angle between road and rail is not right
	Reflecting materials	All level crossings
Stop-signs before level crossing		Investigation needed
	Optimisation of location	Level crossings with stop-signs
Speed limit signs before the level crossing		All level crossings
Portal before the level crossing		Passive level crossings
Traffic mirror at the level crossing		Investigation needed
Signing the optimal place to stop		Passive level crossings
Painting of tracks with reflecting paint near the level crossing		Passive level crossings
Quick alarm to the engine by general emergency number		All level crossings
Laws and regulations		All level crossings
Education and campaigns		Level crossings in general
Enforcement at active level crossings		Active level crossings
Supervision of the state of the level crossing		All level crossings
Updating of regulations		All level crossings
Lights on the engine when the speed is over 35 km/h		All level crossings
Speed limits for trains		Temporary countermeasure
Net across the road		Not applicable (expensive)

Countermeasure	Sub-measure	Applicability
Rumble strips on road		Not applicable (wear out)
'Noisy' pavements		Not applicable (wear out)
Adjustable ramp on the road before the level crossing (Russian application)		Not applicable (no experience on function)
Advance warning on poor sight distance		Not applicable (no effect)
Variable speed limits		Not applicable (expensive)
In-vehicle warning		Not applicable (possible in the future)
Route planning of transportation		No need

Reducing the number of railway level crossings

The most effective way to improve traffic safety at railroad level crossings is to close the level crossing or to build a grade separated crossing. It is possible that the grade-separated crossing is situated in a different place than a level crossing. In that case a new road connection must be built. If there is high-speed traffic (speed more than 140 km/h) on the track no level crossings are allowed in Finland. In long-term plans in many countries railroad level crossings are going to be closed and grade separated crossings built instead.

Active warning devices

Whole barriers

An advantage with whole barriers is that the way to the track is blocked. The level crossing can be equipped with two long barriers or with four-quadrant barriers. Traffic safety effects are positive for motor vehicles. For pedestrians it is still easy to cross the track by going under the barriers. The disadvantages are the price of the equipment and a possibility for a motor vehicle to be trapped between the barriers. The barriers should be made of material that breaks when a motor vehicle drives against the barrier.

Half-barriers

At the railroad level crossings equipped with half-barriers *(figure 1)* driving round the gates is one of the main problems. Short waiting times and the reliability of the equipment are prerequisite for proper traffic behaviour at railroad level crossings with half-barriers. According to the study made in the USA 38% of free vehicles (single vehicles and first ones in queues) crossed the track when the half-barriers were already down. (Meeker & al., 1997)

One problem is the road vehicles colliding with half-barriers. In Finland there are about 800 railway level crossings equipped with half-barriers. During year 1999 there were 164 (about 20%) half-barriers broken in the crashes. The optimisation of waiting times is one solution to this problem.

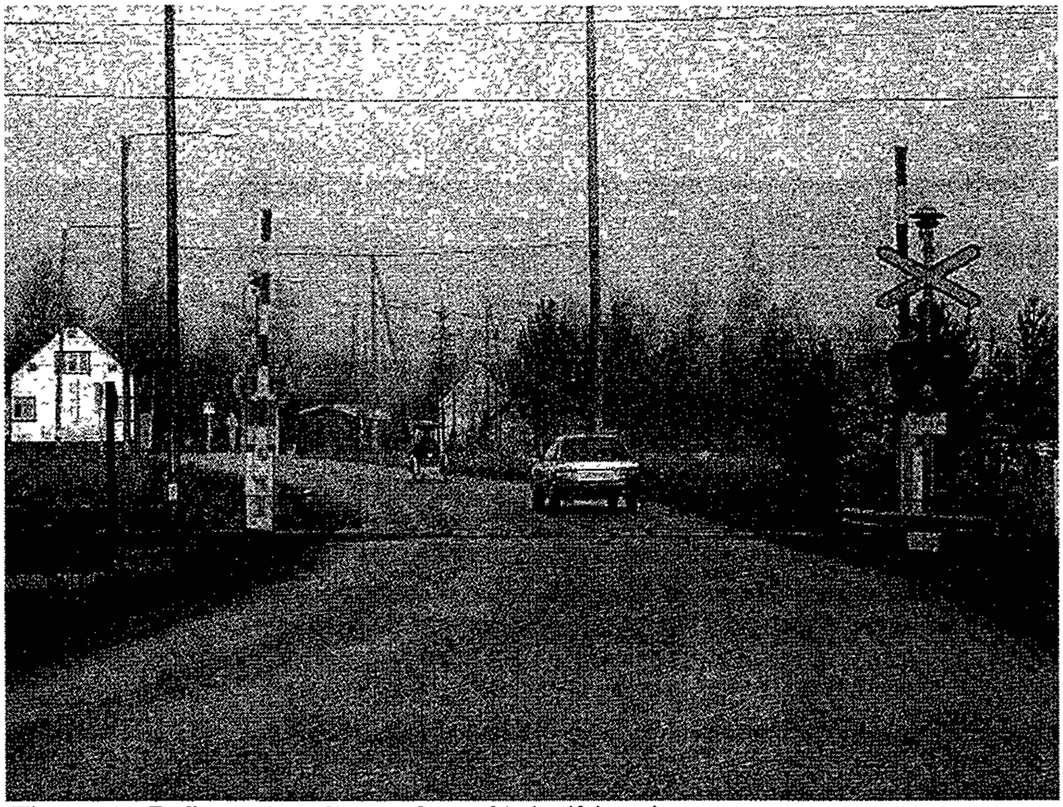


Figure 1. Railway level crossing with half-barriers.

Pedestrians and cyclists go round the gates even more than car drivers do. In Sweden only 20-25% of them stop when the red signal is on, 3-5% go under the barriers and 17% of pedestrians and 65% of cyclists proceed before the red signal is off. (Vägverket, 1998)

Flashers and warning bells

At the level crossings with flashers and warning bells the waiting time should be optimised, function reliable and it is important for the road user to be able to distinguish the light also when the sun is shining at the driver or in the dark.

There are several reasons for driving against the red signal. It is possible that the driver does not observe the signal. The strobe lights or LED's could make the signal more distinguishable. The driver can drive against the 'fresh' red signal, if she or he presumes to be able to cross the track before the train comes. It is also possible that the driver is tired for waiting for the train and drives against the red signal presuming that the train does not come this time. Keeping the waiting times as short as possible (the equipment should be able to detect the speed of the train) can help to solve these problems.

Warning signal for one domain

In Sweden and Norway they have used a simple warning signal at the level crossings with one track and very low volume private road. There is a normal light bulb at the level crossing and the light is on when the train is not approaching the level crossing. If the light is off the train is approaching or the bulb is broken. This solution is in use if the road connection is just for one domain and they make a contract with the owner of the domain. This kind of warning device is not defined in law. The experiences of the system are good and they are building more of those in Sweden.

In Finland we are testing a same type of device called level crossing signal. There is LED situated in the middle of the cross buck. The light is on when the train is approaching. There are axle counters detecting the train. The equipment gets its power from solar panels and wind turbine. The road is planned to be a private road with low traffic volumes and there is no need for it leading to just one domain. For now only a prototype of the device exists.

Passive level crossings

Stop-signs

Stop signs are found to have positive effect on traffic safety at level crossings in Finland. The drivers do not necessarily exactly stop but they reduce their speed significantly before the railway level crossing. There are also level crossings where stop signs are not a good solution. That can be for example if the gradient of the road before the level crossing is high. The location of stop signs should be optimised for example according to sight distances from the road. *(figure 2)*

Figure 2. Railway level crossing with stop signs.

Improving the sight distances

One of the most common problems at railway level crossings is the insufficient sight distances. Poor sight distances are often the problem at railway level crossings with private roads. Often the solution is very cheap and simple, just clearing the vegetation. There can be also construction waste blocking the sight to the rail. A building can also block the sight. If the building is not in use it could be torn down. It is also possible to move some buildings. During the wintertime the snow should be driven away from the crossing.

It is sometimes almost impossible to improve the sight distances with reasonable costs. There can be big buildings situated near the level crossing, the terrain can block the sight to the rail or there can be a sharp bend on the track near the level crossing. In those kind of locations grade separation is one solution to the problem. Reducing the speeds of the trains gives road users enough time to cross the track safely.

Adjustable ramp on the road before the level crossing (Russian application)

As an example of new innovation is the adjustable ramp on the road before the railway level crossing they have been developing in Russia. *(figure 3)* The device is used at the level crossings with half-barriers to prevent the road users from proceeding when the train is approaching. This is a new solution and there is no experience on how well it is functioning. There are no plans to try this equipment in Finland.

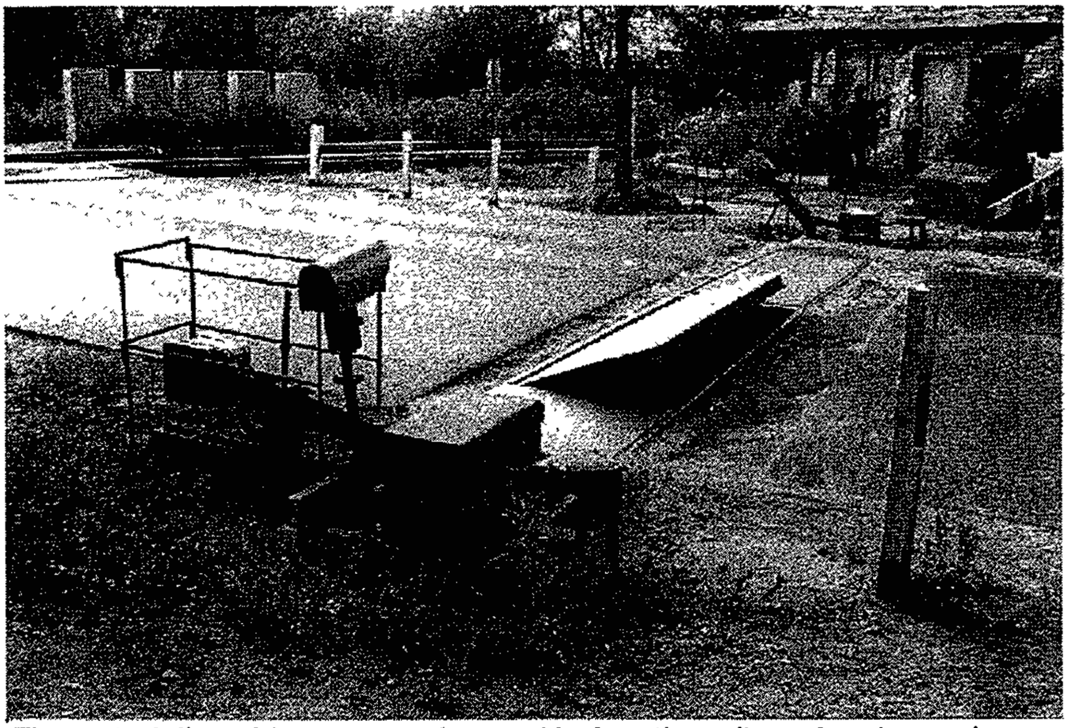


Figure 3. Adjustable ramp on the road before the railway level crossing.

Conclusions

The aim of the study was to collect a list of existing ways to solve the problems with traffic safety at railway level crossings and to innovate some new countermeasures. Relevant factors affecting the safety at railway level crossings are for example the type and traffic volume of the road, speeds of vehicles, number of tracks and the speeds of trains. According to those factors a proper countermeasure or set of countermeasures should be tailored to each railway level crossing. There are low cost countermeasures, which can be executed immediately (e.g. clearing of vegetation to improve sight distances). There are more complicated and more costly countermeasures that need time and could be executed in long term (e.g. building of grade separated crossing).

Acknowledgements

This research was financed and published by Finnish Rail Administration.

References:

Godziejewski, B., Lochman, L., Hirao, Y., Level crossings – comparison between Europe, USA and Japan. Presentation in World Congress on Railway Research, Japani, Tokio, 1999. 7 s.

Meeker, F., Fox, D., Weber, C. A comparison of driver behaviour at railroad grade crossings with two different protection systems. Accident Analysis and Prevention, Vol 29, 1997. Pp. 11-16.

Orsaker till döds- och personskadeolyckor vid plankorsningar mellan väg och järnväg, (Reasons for fatalities and person injury accidents at railway level crossings), Regeringsuppdrag, Utredning. Vägverket, Publikation 1998:36. 32 p. + app. 2 s.

International Rail Safety Conference

2000 LONDON

8 November - 10 November 2000
Forum Hotel, London, United Kingdom

Paper 0013

Mike Lowenger

Trespass Prevention: Public Collaboration and Partnerships

Publisher
2000 International Rail Safety Conference

International Rail Safety Conference

Mike Lowenger

Vice President

Railway Association of Canada

Trespass Prevention - Public Collaboration and Partnerships

Trespass Prevention: Public Collaboration and Partnerships

International Railway Safety Conference
8-10 November, 2000
The Forum Hotel
London, England

Mike Lowenger
Vice President, Operations & Regulatory Affairs
Railway Association of Canada

Introduction

On behalf of the various stakeholders in Canada working in partnership arrangements to prevent trespass related fatalities and injuries on railway rights of way, I would like to express my thanks to the organizers of this conference for allowing me the opportunity to discuss one of the most important safety issues facing our industry.

In general, railways provide a very safe means of ground transportation in Canada. Over the years, Canadian railways have continued to achieve dramatic improvements in safety. The number of main line derailments, for example, has been cut in half since 1984. Canadian railways are also among the safest railway companies in North America and in the world.

Railway employees are considered to have the safest jobs in the transportation sector. Their jobs are also safer than those in other heavy industries in North America. In Canada, lost time to injury among railway workers is roughly half that of marine shipping workers and 1/3 less than in commercial trucking and airlines

Still, approximately 100 people die each year on railway property and many others are seriously injured. More than 95% of these fatalities and injuries occur at highway-railway crossings or involve trespassers on railway property. Approximately one-half of these are trespass related and this proportion has been on the increase. For the most part, trespasser incidents occur because people misjudge the speed of trains and the time required to get out of harms way. They involve people who take strolls down the track or "short-cut" across the railway right-of-way and get struck by a train.

Passenger trains travel up to 160 km/h. Obviously, trains can't swerve. A freight train can take more than one full minute and about 2 km to come to a complete stop.

In virtually every case, these accidents were caused by drivers (including ATVs and snowmobiles) and pedestrians who put themselves in the wrong place at the wrong time. It would seem that most of these incidents could have been prevented.

The good news is that we have witnessed a decline of approximately 60% in the number of crossing collisions and trespassing incidents since the early eighties. This was achieved despite major increases in vehicle registrations, more trucks on the road, most of which are larger and heavier, endless urban sprawl and new development adjacent to railway facilities and rights of way. In some regions, the are more trains, including high-speed passenger and commuter operations.

How did we accomplish this good news story? The answer is, through multi-stakeholder safety partnerships.

We are overcoming the traditional and narrow view that these safety concerns are a "railway problem". We are putting behind us a history of laying blame and passing the buck on responsibility for dealing with unsafe conditions at railway/highway grade crossings and railway rights of way. We are coming to grips with traditional problems and long standing diverging views on such issues as

1. Train whistling in communities
2. Appropriate access control measures and related community responsibilities
3. Indiscriminate urban planning, and
4. Understanding joint responsibilities at railway/highway grade crossings.

Historically, few paid attention to these kind of issues until something happened. Now, we are all increasingly engaged in prevention strategies and action plans, in partnership arrangements with all affected stakeholders. There is no doubt that these partnership approaches have, and will continue to yield the best results, in the most cost effective manner, and for the most sustainable period.

I would like to spend the next few minutes outlining some excellent programs and initiatives that illustrate the merits and successes of the partnership approaches related to trespass prevention.

Operation Lifesaver

Probably the most influential and successful partnership program involving public safety, since its inception 18 years ago, has been Operation Lifesaver. The RAC is a co-sponsor of the Operation Lifesaver program with Transport Canada. The program is run in cooperation with national and provincial safety organizations, police (both public and railway) and public service groups.

Operation Lifesaver disseminates publicity and educational material and draws on approximately 500 volunteer presenters to bring the message of extreme caution at crossings to schools, driver education courses, the media and the general public.

As well, Operation Lifesaver is concerned with the growing problem of incidents due to trespassing on railway property.

Many of the volunteer presenters are railway employees, police departments, and public service volunteers. Railway labour unions, particularly, our train drivers, the Brotherhood of Locomotive Engineers, have been particularly supportive of the campaign. These individuals can provide a very passionate message related to the consequences of trespassing onto railway property.

Operation Lifesaver is currently in the process of recruiting and training 200 - 300 more presenters from various public law enforcement and community stakeholders.

Direction 2006

Direction 2006 is our most ambitious and exciting partnership program to date. This program involves all stakeholders in crossing safety and trespass prevention. It involves various communication strategies, awareness and education initiatives, enforcement partnerships and research and legislative projects.

D2006 began with a mandatory review our Railway Safety Act, conducted by outside consultants, in 1994. The final report, entitled "On Track", concluded that the Railway Safety Act framework was working well and that Canada's railways were amongst the safest in the world.

The report made 69 specific recommendations including several related to improving grade crossing safety and reducing trespassing incidents. The recommendations encouraged multi-stakeholder involvement and suggested the establishment of a cross-functional program aiming to reduce grade crossing and trespassing incidents by 50% over a 10 year period.

The Minister of Transport agreed with these recommendations and objectives, and the D2006 program was ultimately established. Between 1995 and 1998, many partnership agreements were implemented and national consultations conducted. Key partnerships were developed between Transport Canada (the regulators), the railways and the Provincial Departments of Transport. Other stakeholders have also engaged the D2006 program including the Federation of Canadian Municipalities, railway unions and the Transportation Association of Canada.

D2006 has an Executive Committee which represents the various key stakeholders and directs the overall program. The development and delivery of the various component programs of D2006 are carried out by 7 specific working committees:

- Education
- Enforcement
- Communications
- Research
- Legislative
- Resources
- Performance Measurement

The key objective of the Education Committee is to ensure that municipalities and communities better understand their roles and responsibilities for trespass prevention and access control To this end, the committee developed a comprehensive "*Community Trespass Prevention Guide*". The guide provides guidelines and job aids for trespass site evaluations, public surveys and questionnaires, developing strategic partnerships, and implementing appropriate action plans. The guide has been distributed and promoted to thousands of community stakeholders across the country. As a result, many community pilot projects have been established.

The Education Committee is also developing strategic videos on trespass prevention which also target the growing dangers related to snowmobiles and All Terrain Vehicles (ATVs). Radio and television public service announcements, some very graphic but effective, are also part of the committee's trespass prevention program.

The mandate of the Enforcement Committee is to promote more public policing of railway trespassing, to include a rail safety component in public police training activities, and to target specific high risk trespassing locations and situations with appropriate prevention programs.

To date, approximately 200 new community services officers have been trained as Operation Lifesaver presenters. In addition, rail safety awareness has been added to police academy curriculums across Canada. Strategic "*Community Trespass Prevention Guide*" pilot projects have been

established in various communities across the country including some particularly successful ones in Ontario and British Columbia.
The Communications Committee is responsible for delivering the various key messages of D2006 to all relevant stakeholders. This committee has developed the D2006 logo, established the D2006 web-site / hot-links and undertook professional public opinion polling on the subject of trespass prevention including consultation with public focus groups from differing communities and environments (e g. urban vs farm).

The Research Committee has been mandated to conduct various types of studies on railway trespassing This includes behavoural factor research into public perceptions concerning access to railway property and academic / industrial research into new technologies.

A $1.4M. Research program has been undertaken by the Transportation Development Centre of Transport Canada, funded jointly by the Federal government, the railway industry and the provinces. Of the 17 projects approved to date, several involve trespassing issues including research on accident causes and remedial actions, and a high speed locomotive horn study.

The Legislative Committee has the responsibility to promote provincial harmonization of successful trespass prevention strategies and guidelines, if possible, through legislative / regulatory means. A key project involves the promotion and implementation of a national "Urban Setback Policy", to be developed in collaboration with the Canadian Association of Urban Planners. The policy will provide much needed direction and guidance for land development adjoining railway rights-of-way.

The Resource Committee is mandated to ensure that the D2006 program is adequately resourced and funded where necessary. Transport Canada contributed $250,000 CAN to D2006 programs in 1998 and recently approved a $1.7 M. business plan for 2000-2002.

The Performance Measures Committee has just recently been established and their job will be to collect trespass related data / feedback and develop appropriate performance indicators that measure the success of the D2006 program.

It would seem that the D2006 program is beginning to pay dividends. In 2000 (to end September), according to statistics published by the Transportation Safety Board of Canada (TSB), trespass fatalities fell by 29% versus the 1995-1999 average while serious injuries fell by 38%.

Trespass Prevention Through Environmental Design

Another exciting partnership initiative, pioneered by the railway industry is "Trespass Prevention Through Environmental Design". This encompasses a basic strategy for trespass prevention which involves all community stakeholders. Simply stated, the strategy uses environmental design to eliminate railway/public conflicts.

This is accomplished in 3 ways:

1. Natural surveillance;
2. Natural access control, and

3. Territorial reinforcement

Natural surveillance involves various means of observing intruders and increasing their perception of risk in being reported, ticketed or convicted. This approach can involve railway and public polices forces, private landowners, school administration and staff, municipal businesses, restauranteurs, and even camera technology.

Natural access control is a strategy to decrease trespassing opportunity by denying access to a railway right of way. This involves the strategic use of distance or topographical features that direct activity or create a buffer between conflicting railway/pedestrian activities. Examples include the installation of strategic lawns, textured surfaces or other landscape, sidewalks, creeks, etc.

Finally, territorial reinforcement strategy involves ways and means to use physical design to create a sphere of influence such that the users of the property develop a sense of "proprietorship" over it. An example would involve sale or lease of a strategic section of property to interested parties who would cultivate it and discourage trespassing. All these strategies help reduce the desire to trespass.

For a successful implementation of the environmental design approach, strong partnerships need to be developed between the railways, public agencies and the communities.

Oshawa Community Trespass Prevention Project

The "Oshawa Community Trespass Prevention Project" has been very successful in implementing many of these principles to address their trespassing problems. Community partnerships were established between CN, CPR, Transport Canada, City of Oshawa, Region of Durham, Durham Regional Police Service, Operation Lifesaver and the local business community.

The problem locations were established, statistics and near collision reports were reviewed, the make-up of the surrounding area was studied and environmental issues were reviewed.

An education plan was developed which included the training of local police as Operation Lifesaver presenters, community events to raise awareness, media blitzes, school presentations etc.

The community began to observe and report trespassers Access to railway lines was denied through natural and structural design elements. Property lines were more clearly defined and alternate routes were clearly marked and encouraged. Fences and stairs were installed at strategic locations New "High Visibility" signs were installed.

On the enforcement side, a multi-agency enforcement partnership was established and both random and targeted trespass and crossing enforcement was carried out.

The overall program has been a major success in Oshawa, resulting in less incidents, less complaints and a satisfaction in working together on a common objective.

Other Safety Partnerships

The list of successful partnership initiatives is growing.

- The "Niagara Railway Safety Task Force" was set up in 1999. They developed a railway safety strategy focussing on education, engineering and enforcement. A major media campaign ensued. A specific municipality in the region was convinced to lower the speed on a rural highway at a railway grade crossing to help reduce the risk of collisions. Increased enforcement of trespass and traffic laws by railway and municipal police forces continues to be part of the Niagara safety strategy.

  There are plans for a railway safety poster contest and a video developed in partnership with a local cable station.

- A pilot project was also established at the Resort Municipality of Whistler, B.C. where challenging trespassing concerns (on B.C. Rail property) are being created by the transient nature of the vast amount of tourists frequenting the resort community, including associated language and community barriers.

  Data was gathered by BC Rail and local police groups through interviews with local residents, tourists, railway crews, local businesses, schools, golf course personnel, sports rental companies, chamber of commerce, RCMP, and tourist information agencies.

  In 1998, following a pedestrian accident at a crossing in Toronto, GO Transit, worked with community partners such as Railway Health and Safety committees, Operation Lifesaver and others to initiate a poster campaign. There posters, cautioning passengers on the safe movement around trains, were placed on all GO Transit and stations.

  The success of this campaign has been recognized and implemented by other commuter environments in Canada.

Government / Agency support of partnerships

Today, the partnership approaches that effectively deal with crossing and trespassing safety issues are regularly promoted in reports produced by Federal and Provincial investigative agencies. In addition, the federal courts and railway regulators are providing decisions and rules that support shared responsibilities and partnership solutions.

Recommendations in various TSB occurrence reports for crossings accidents and right of way incidents, as well as in provincial coroner reports, direct all stakeholders to work together and work to proactively reduce the risk of collisions and trespass incidents. A recent Coroner's report following a tragic 1996 fatal accident near Windsor, Ontario is an excellent example of recommendations involving partnership solutions. The result has been a collective and aggressive campaign to ensure these reckless incidents do not occur again.

Some of the recommendations included:

- Municipal by-law to remind home-owners of their responsibilities to maintain fences abutting on railway rights-of-way and provisions to enforce with costs through property tax bill.
- Coroner to convene safety summit with all stakeholders to develop school safety initiative which could serve as a collaborative model for the Ministry of Education.
- Attorney General of Ontario take appropriate measures including increasing amount of fines, developing a more effective process of collecting fines and amending the Trespass to Property Act to require notice to parents for incident involving children 18 years of age and under.
- Both railway and local public police forces increase their inspection / enforcement activities.
- The Railway Association of Canada develop and implement an appropriate public relations strategy (Accomplished under D2006)
- Minister of Municipal Affairs and Housing to establish a Regional Planning Committee to address urban planning safety issues and implement related guidelines. An immediate review of newly approved development projects near or adjacent to railway property in the vicinity of the fatal accident be carried out and remedial measures taken where appropriate.

The Canadian Transportation Agency (CTA) has ruled many times on disputes between railways, road authorities and municipalities governing costs related to crossing improvements and trespass prevention. The CTA continues to rule that responsibilities are shared and that costs, both capital and maintenance, are usually shared according to who benefits, who changed the environment and who is responsible by law and by commercial agreement.

A landmark case was decided by CTA order on August 29, 1996. The City of Toronto, Ontario had developed a new bicycle trail in parkland adjacent to a railway main line. This situation created a new trespass situation whereby trail bike enthusiasts began to explore terrain off the designated trails and across railway rights-of-way. As a safety response, trains began to whistle regularly through the heavily curved, downtown trackage, raising the ire of local residents.

In the end, the railway agreed to install 20,000 feet of six foot high chain link fence at its own expense, but went to the CTA for a cost apportionment decision. The Agency was of the opinion that the railway fencing was a benefit to both the railway company and the adjoining party (City of Toronto) and recognized the obligation of both parties to offer protection to the public.

Accordingly, the Agency ruled that both the cost of the installation as well as the cost of maintenance of the fence be shared equally between the applicant (railway company) and the Municipality of Metropolitan Toronto. It is no surprise that following this decision of the Agency, there has been no further disputes of this nature and, rather, a negotiated partnership approach for dealing with trespass situations.

These decisions have caused other parties to pause and reflect on negotiating low cost, sustainable partnership solutions rather that going to court.

Railway Safety Act

Changes to the R S A. in 1999 also signalled that appropriate changes are being made to the regulatory framework and environment which reflects current safety realities in the field.

Locomotives whistle for public safety reasons. Under the recently amended R.S.A , a railway may be prohibited, by a municipal resolution, from whistling in certain areas within its boundaries, if the crossing meets regulatory safety requirements. These requirements cover trespassing situations.

Before passing such a resolution, the municipality must consult with the railway, notify each relevant association and give public notice of its intentions.

Transport Canada is developing new regulations governing access to railway property and safety standards related to highway/railway grade crossings. Even the development of these regulations is undergoing a partnership approach. A working group of Transport Canada personnel, railways, railway unions, Canada Safety Council, the Federation of Canadian Municipalities and provincial DOTs is meeting regularly to review safety issues and develop a draft regulation.

The proposed access to railway property regulation has significant shared responsibility elements, such as:

1) Communication requirements for safety issues;
2) Joint safety assessments and accident review;
3) Responsibilities for Access control measures governing changes to rail operations
4) Responsibilities for Access control measures governing changes to land use.

As can be seen, the partnership approach to dealing with trespass prevention is an obvious solution.

Summary

From the railway industry point of view, we would still like to see more involvement from provincial and municipal authorities and related communities.

Although crossing and trespassing incidents represent almost all of railway related fatalities and accidents, they are only a fraction of the 3000 killed and 240,000 injured in Canadian highway accidents across Canada each year. Still, the railway related portion could be easily reduced further with an appropriate increased level of awareness and involvement of these stakeholders.

There is no doubt that partnership approaches yield the best results, in the most cost effective manner and with solutions that are more sustainable in the long term. Canadian railways and their rail safety regulators will continue to take a leadership role to ensure that these strategies continue to be implemented successfully

International Rail Safety Conference

2000 LONDON

8 November - 10 November 2000
Forum Hotel, London, United Kingdom

Paper 0014

Terry Atkinson

Benchmarking of Safety Parameters: Results

Publisher
2000 International Rail Safety Conference

International Rail Safety Conference

Terry Atkinson

Manager, Rail Safety

Land Transport Safety Authority of New Zealand

Benchmarking and Safety Parameters - Results

TA9.6.1Lon2000

BENCHMARKING OF RAILWAY SAFETY DATA

NEW ZEALAND PROJECT – PROGRESS REPORT

Paper by Terry Atkinson, Manager Rail Safety, Land Transport Safety Authority of New Zealand

To be presented at the 2000 International Railway Safety Conference, The Forum Hotel, LONDON, United Kingdom

8-10 November 2000

1. INTRODUCTION

In my paper to the 1999 International Rail Safety Conference in Canada, I indicated that the Land Transport Safety Authority of New Zealand (LTSA) had commenced a project to determine "best practice" in railway safety around the world.

I suggested that the annual International Railway Safety Conference brings together many of the world's railway safety professionals who may be expected to have a common interest in being able to set benchmarks and compare statistics relevant to the experiences of their own organisations.

Indeed, proposals to form a "benchmarking club" were first made to an earlier meeting of this Conference eight years ago.

The following are quotes by Mr David Maidment of British Rail from his paper presented at the 1992 Conference held in New Zealand:

"Queensland Railways sought to collect information about safety on a comparative basis....."

".. ...many of the responding railways were unable to provide data in a common format or to common definitions"

"......last year (1991) we identified the need to attempt to develop common definitions and data supporting risk assessment......"

"Do we perhaps in the longer term form an international railway association to collect, manage and distribute data to the members of that association?"

"Does one of the participants at this Conference wish to act as an agent on behalf of all of us in co-ordinating the definition of data required and analysing the results?"

In fact it took from 1992 until 1999 for this agent to be identified – the LTSA of New Zealand.

Research by the LTSA has indicated that many individual railways and regulatory agencies collect data on safety statistics relating to their immediate area of interest there is little interchange internationally and benchmarking against "best practice" is currently extremely difficult.

This view appears to be reinforced by the experiences in attempting to collect data for the current project through the year 2000 and it has become evident to the author that the LTSA has embarked on a project of not insignificant difficulty.

International benchmarking work is essential to New Zealand because the country has only one major railway. As safety regulator the LTSA needs basic performance measures to allow definition of tolerable safety performance of our railway and measure the effectiveness of safety regulation by comparison with "best practice" standards, whatever and wherever these may be.

As many individuals working in the transport safety area will be aware, the Federal Highway Research Institute (BASt) of Germany established the International Road Traffic and Accident Database (IRTAD) in the mid eighties In 1988 the database was extended in close co-operation with the Commission of the European Communities (CEC). Since 1990 the database has operated within the framework of the Organisation for Economic Co-operation and Development (OECD) Road Transport Research Programme and includes now data from all OECD countries with BASt acting as database host and administrator.

It would be very advantageous for such a database to operate internationally in the area of rail transport and the LTSA would like to see the co-operation of organisations such as the OECD in attempting to bring this to fruition.

It was very evident at last year's conference that many delegates were in agreement with the principles originally outlined by Mr. Maidment and now several years later proposed by the LTSA. Several delegates indicated they would be prepared to supply data to such a project.

By general consent of the delegates the LTSA of New Zealand undertook the task of "founding" co-ordinator.

2. WHY BENCHMARK?

For effective management of their businesses, railway managers need to have a means of measuring the relative safety of all aspects of their operation.

Measurement of a number of key parameters and meaningful comparison with similar values externally can give a measure overall of the "safety heath" of the business in relation to normally accepted operating practice or even best practice if this can be identified.

By doing this type of assessment, rational and justifiable management decisions may be made to allow the "safety dollar" to be invested in areas providing the most effective returns in relation to acceptable levels of risk as consciously defined by the business management process.

It is suggested that there are two ways in which this measurement may be accomplished:

- Assess previous failures by recording the occurrence of accidents and incidents as reported by the organisation in a number of safety critical parameters, determine trends and prescribe action to be taken in relation to tolerable risk. Targets may be set for continuous improvement towards zero tolerance.

However, occurrence statistics may not, in themselves, be a totally reliable indicator of the inherent risks present in railway operations. It is also important to be able to predict the propensity to have a major unsafe occurrence even though favourable safety indicators have predominated for some time.

This requires a more rigorous analysis and managers must be constantly aware that complacency is dangerous. Sleepwalking to disaster is likely to result in a most uncomfortable awakening.

The second way is to:

- Analyse the safety problems of the organisation by learning the lessons of others from benchmarked practice (say from similar external local competitors or from overseas).

Risk control measures are taken in the areas of greatest deviation from industry norms or from lessons to be learned in the avoidance of occurrences in comparison with previously recorded similar events elsewhere

This is a best practice approach that provides evidence of an organisation's "due diligence" and removes the possibility of accusations of negligence if no good reason for the non-adoption of certain risk mitigating controls can be given.

This process should ideally be coupled with the reporting and recording not only of actual accidents and incidents but also of near misses. However, near miss reporting can only be effective in situations where employees are sufficiently motivated to report occurrences, which may be self – incriminatory or critical of colleagues.

The difficulties associated with the establishment of this type of culture into the traditional management style of the railway industry cannot be underestimated.

Such a pro-active approach to the building of a fence at the top of the cliff to prevent unsafe events is only gradually becoming accepted by the railway industry as a valid means of managing its safety issues.

Fundamental to this approach is the establishment of a "learning organisation" and the promotion by senior management of a "no blame" culture of open reporting and confidential disclosure.

This is designed to provide a cultural environment based on the acceptance that the skills and attitudes of all a company's staff should be focused on the delivery of safe outcomes measured against external indicators It demands a "hands on" and enlightened management style with a pro-active involvement of the labour unions.

The result should lead to the "safety dollar" being spent effectively on prioritised accident prevention projects with the objective of reducing the chances of occurrence of (perhaps low probability) major unsafe events as well as less onerous but nevertheless equally significant minor unsafe occurrences.

As previously noted the collection and sharing of safety information is fundamental to this management concept through the reliance on external comparisons to assess the local situation.

The risk assessment of newly proposed or amended processes prior to implementation is also necessary. This is to ensure any changes in the organisation's risk profile are recognised and remain tolerable.

3. DATA SOURCES

At the outset of the LTSA project it was though the Internet would be a good source of railway safety statistical data. In fact it was only possible to discover, in any detail, the published statistics from the USA, Canada and Great Britain.

The Paris based UIC (International Union of Railways) which has 147 member railways worldwide, publishes railway commercial statistics on the Internet and advertises a supplementary table (A91) to its annual statistics, covering railway operating accidents. This table is sparse in its detail and is only available for purchase. However, when compared with the amount of detail included in the UIC commercial statistics it provides good evidence that railway safety data is extremely difficult to obtain.

Recent information suggests the UIC is embarking on a new initiative to compile a safety database to be used for exchange of information, risk assessment, active safety management, safety case preparation and comparison with other transport modes.

The information from the USA is that provided by the Federal Railroad Administration (FRA) on its web-site. It is very comprehensive. Its tabulated data refers to individual railroads as well as a breakdown by US States.

The information from Canada is that provided by the Transportation Safety Board (TSB) on its web-site It is comprehensive (though less so than the FRA information) and does not attempt to reproduce data from individual railroads but presents "All Canada" totals.

The information from Great Britain is that provided by HM Chief Inspector of Railways of the Health & Safety Executive on its web-site. The latest summary report bulletin and the Annual Report of the

Railway Inspectorate published in October 1999 relate to the year ending 31 March 1999. The UK report analyses incidents and dangerous occurrences between four main groupings of railway companies (Railtrack/Train Operating Companies, London Underground Ltd., Trams and "other") for the whole of the UK and separate splits of selected statistics for Scotland and Wales.

Many individual railways around the world have web sites but information safety information is rarely disclosed.

In realising the limitations of the Internet approach, the LTSA prepared a questionnaire, which was distributed via e-mail to a number of railroads and regulatory agencies, including the majority of those that attended the 1999 International Rail Safety Conference

4. THE QUESTIONNAIRE

In December 1999, the LTSA distributed 39 copies of a questionnaire requesting numerical data relating to a number of safety parameters. The data requested was to represent each of three individual years 1997-99, which could be represented by the agency's fiscal year or for each calendar year.

The parameters chosen were based largely on those contained in the statistical reports of the FRA and the UK Railway Inspectorate, and were:

- (3) Annual total of all reportable occurrences;
- (4) Fatalities and Serious Injuries to Passengers, Employees, Public (including Trespassers);
- Lost time Injuries;
- (5) Level Crossing Collisions
- (6) Derailment of running trains and "other" trains
- (7) Collisions
- (8) Signals passed at danger (SPADS) and Warrant over-runs;
- (9) Loading irregularities;
- (10) Dangerous Goods;
- (11) Fires, fumes and explosions;
- (12) Technical failure;
- (13) Vandalism/Sabotage.

The numbers in parenthesis above refer to the Sections of the questionnaire (and see Table 1 below).

Additionally, questions on railway operational data and demographics were included to allow normalisation of the results (14 1/14.2).

The basis of the questionnaire was to allow the recording of statistics at three levels of detail:

- HIGH. comparison of accidents taking account of fatalities to produce a fatal accident rate (FAR) and serious injuries to produce an "equivalent fatal accident rate" (EFAR). These were to be categorised into accidents to employees, passengers and public and to include level (grade) crossing highway statistics. (Note: For EFAR 10 serious injuries are equivalent to 1 fatal).

  These were thought to be readily comparable across various different operational activities of a number of different types of railway and reasonably indisputable

- SECONDARY comparison of serious operating irregularities such as collisions, derailments, insecure loading and signals passed at danger (SPADS) were to be analysed.

  Although many railways record such data the definitions of the information collected becomes increasingly critical and accuracy of reporting/data collection dubious. Consequently it becomes difficult to make meaningful comparisons. For this reason the questionnaire specified the definitions to be used and requested respondents to note where their definitions differed from those specified.

- LOW. comparison of data such as that associated with infrastructure or mechanical failures (defective rails, track buckles, defective rolling stock etc.). It was expected that most railways would record such defects. However, it was also recognised that the accuracy of the records would be likely to be understated as many defects would not be reported if found by testing or during the normal course of maintenance.

Given the need to ensure that the high level and secondary level occurrences are reported on a consistent basis by agencies sharing benchmarks, which would require a coordination process of some difficulty, it was thought perhaps not worthwhile to pursue comparison of low level data for the current study.

It is accepted that low level occurrences (including near misses) are a measure of underlying safety issues. These can have great significance to effective safety regulation but at this stage high level data incorporating actual fatalities and serious injuries and the consideration of secondary tier data emerged as a more satisfactory basis for making meaningful comparisons

However the questionnaire, contained questions on all levels of data and proved to be a document of some consequence. The fact that many respondents were unable to offer information on the lower levels of data appears to vindicate the thought that collection of such data should perhaps be consigned to the "too hard" box for the time being.

With the benefit of hindsight, the author wonders if the great detail required by the questionnaire was a factor in the slow response from many participants and the complete lack of response from others

Commentary was received from certain organisations that this level of detail was not available within their organisation.

It is not easy to understand why.

As responses were initially very slow to arrive, during the data collection period, the requirement for detailed response was relaxed in order to encourage a greater number of respondents. The collection of only high level and some secondary level data was given priority, irrespective of any respondent's inability to reply to the lower level questions.

For successful international benchmarking purposes there is a need to recognise common definitions of safety occurrence data and a common set of normalisers, to ensure the definitions of apparently similar indicators used by different entities allowed the collection of comparable data and the statistical analysis does not likewise mislead.

It was pointed out in the questionnaire that the definitions and normalisers supplied to the project need not be at the expense of individual agencies' normally accepted data presentation but in addition to it.

Although the LTSA questionnaire proposed definitions for every parameter to be measured there was no intention of imposing these on the participating agencies except for the sole purposes of this exercise. The questionnaire also requested that any inability to give data reasonably within these definitions should be noted in the response.

5. RESPONSES

The questionnaire was first distributed at the end of December 1999, initially to thirty-nine railways or transport agencies. It was realised that in some cases only one response would be required to questionnaires sent to several agencies. In the case of Canada for instance, questionnaires were sent to Canadian National Railway, Canadian Pacific Railway, Via Rail, Transportation Safety Board, Transport Canada and Railway Association of Canada Several other railways in Canada could have also been canvassed However, to preserve requests for confidentiality and a national total for all railways administered federally the statistics used for comparison were the federal totals received from Transport Canada

The figures used for the United States total and BNSF figures were extracted from those published in the Federal Railroad Administration (FRA) Annual Railroad Safety Statistics.

Meaningful results from the questionnaire were obtained from 24 separate entities. As surveys of this type go, this is a high response rate and gives the author considerable satisfaction that this type of project is seen by the rail safety community to be necessary and worthwhile

Table 1 below indicates by X the sections of the questionnaire responded to by individual organisations. In many instances respondents did not complete data for all individual sections. The subsequent analysis was made using the "best fit" of data available, meaning that in some instances the sample used was relatively small. Likewise, in some instances lack of sufficient data made analysis impossible.

This confirmed opinion that comparison of High level and only some Secondary level data is useful towards on-going meaningful comparison of safety data

Although some differences in definitions were noted, in most instances the results have been directly compared and do not appear to result in wide distortions.

N/R indicates organisations represented at the 1999 International Railway Safety Conference, which were invited to respond from which no statistics were received. In two instances comment was received that such data was not collected by the organisation but that it would be initiating systems to do so in the future.

Responses from the large US railways were not too helpful and tended to suggest that the FRA collected all necessary data in a prescribed format, which should be used. This is understandable as reporting to the FRA system is firmly entrenched into US railroad procedures and any reporting to an additional system to different definitions may be seen as an unnecessary business imposition.

The author has attempted to extract comparable data from the FRA statistics for the BNSF (Burlington Northern Santa Fe) railroad and the "All USA" results to allow a reasonable comparison with railways outside of the USA These will be presented in the data but may result in imperfect comparisons

If the current project is to proceed into the future and include US comparisons, some way of rationalising US data into a comparable format will be necessary.

It should be noted that the Wisconsin Central Railroad was able to make a meaningful attempt to present data in the manner suggested by the questionnaire.

6. CONFIDENTIALITY

Several organisations requested that their statistics be kept confidential and in this regard, it was decided that the published results of the project would not provide details of the performance of individual organisations.

Individual respondents will be provided with a chart indicating their position in relation to a range of results and a mean in each parameter.

The requests for confidentiality suggest a certain degree of sensitivity about the results and indeed the UIC has recognised that it will need to overcome possible resistance to the benchmarking work it proposes, citing confidentiality as an impediment.

Commercial confidentiality for a particular reason is perhaps understandable. In one instance of refusal to supply data, the Government railway concerned was in the process of being privatised and concerns were that this process might be unduly influenced.

More general requests to maintain suppression of identity can less be understood. If the problem is shareholder value one would believe sensitivity would only be apparent for worsening trends – betterment should have a positive effect on company value and a successful business should be working in an environment of continuous improvement. If it is to deter competition, one would imagine normal commercial intelligence would negate any secrecy regarding safety perfomance.

It is interesting to note that railways in the USA (the greatest "capitalist" railway market in the world) have no option but to have their safety statistics published annually by the FRA.

Also, the previously mentioned IRTAD annual statistics for road safety appear to have for many years had the support of several nations world-wide without undue embarrassment

The sensitivity associated with the railway statistics is perhaps an indication of why benchmarking of railway safety has been so unsuccessful for so long. For the purposes of the current exercise any problem with confidentiality will be respected.

However, the sincere hope is that future work in this area may be undertaken without suppression of identities. At least statistics summated for individual countries and presented in the IRTAD format would appear to be less sensitive From contacts made during this project the LTSA has realised that currently many rail safety regulators have few measures of their own success or indeed the performance of the railways regulated

The collection of safety data by many administrations around the world, and analysis for meaningful use in safety management within the railway industry is not commonplace. It has not been easy to get organisations to share their data even though there appears to be an appreciation of the need and advantages of doing so.

Where data is collected, it tends to be employed internally with little (if any) comparison externally. Difficulties that are cited for obtaining meaningful comparisons relate to lack of consistency of definitions, inability to justify normalisers and recognition of the wide range of industry profiles and circumstances under which trains are operated.

The only exception is in the USA where the FRA annual statistics allow railroads to make comparisons of their own data against those of other railways. State by State comparisons is also presented.

The problem of lack of measurement appears to emanate from the low technology operational environment of the railway industry and the long tradition of self-regulation of safety issues within Government owned railways

In an initial pilot exercise conducted in 1999 the LTSA showed how it was possible to present meaningful international statistics by presenting compared data received from seventeen countries in a limited number of safety parameters and also utilising data available from published material.

The range of the results is shown in Table 2.

This Table which, for the majority of surveyed railways, represents the average of 3 years data is presented in this paper because a full analysis of the data received during 2000 has not been completed at the time of writing. It is expected this information will be made available at the IRSC conference session in November 2000.

All other results will be subsequently made available for the individual members to interpret their position in comparison to other internally available data to allow them to make their own judgements as to the relevance of the results to their own situation.

7. STRIVING FOR CONTINUOUS IMPROVEMENT

Railways are inherently hazardous but the most important safety target that the industry can set itself is to strive through a continual improvement process for zero defects.

From the results analysed however it is interesting to note the level of consistency year by year of the values recorded by individual railways in each safety parameter.

Making allowance for the occurrence of statistical clusters, it is relatively easy to recognise that some organisations are so consistent in their annual return of defects in each parameter that one can almost imagine the organisation is predetermined to fail at this level. Any improvements appear to be relatively marginal unless attention is focused on specific parameters and action designed to "break the mould" prescribed.

Priority for attention must be determined from the assessment of greatest gain.

As society becomes increasingly demanding towards its right to remain safe it requires railway operations to be managed with "no harmful events" as the only entirely satisfactory outcome.

In doing so, the ultimate target is very unambiguous. Only by embarking on a road of continuous improvement can we ever hope to arrive anywhere near "destination zero" If we don't have such a goal in mind we have no measure of our progress

Some people strongly argue that because such targets are unattainable a "zero risk" approach is misleading and others argue it is implicit in the conscious achievement of acceptable levels of safety.

The issue is not so much that zero risk is unattainable but that the price of getting there may be prohibitive and even if all risks could be designed out of processes, the end products could well be impractical

In any analysis of hazard mitigation, a cost/benefit approach provides the necessary justification for demonstrating both understanding of business risk and fiscal caution – necessary to ensure steps taken in relation to safety solutions do not compromise the viability of the business.

As indicated previously, it is neither economically feasible nor administratively practical to prevent *all* mishaps If organisation culture and management focus is on control of safety through application of risk management techniques, many potential accidents can be prevented. Organisations can also make an ongoing and steady reduction in the incidence of unsafe occurrences by understanding the "out of control mechanisms" that are operating to produce unsafe situations. This is the "continuous" improvement for which all responsible organisations should strive

For example, the problem of vehicle/train collisions at level crossings in the USA has been the subject of considerable concern over many years. A public awareness campaign "Operation Lifesaver", focused on the problem in most States, was introduced in 1972 and is claimed to have prevented to date over 10,000 deaths and 40,000 injuries. Since 1990 fatalities have dropped 42% despite a 20% increase in highway and freight rail traffic.

The Federal Railroad Authority (FRA) has a goal of "zero tolerance". However, it accepts that it is still necessary to build on the lessons so far learned and to accelerate the pace of investment and implementation of control measures before it will remove all risks from road vehicles physically crossing railways at grade.

Indeed the only zero tolerance solution is to ultimately achieve grade separation at all sites. Realistically, the cost of doing so will ensure this never happens.

In fact it is also certain that in the wider sense, zero tolerance risk will never be attained but will at best after many years of considerable investment in safety follow the time line asymptotically.

This however does not disqualify the setting of the goal.

8. CONCLUSION

There is nothing too clever about accident investigations or the outcome of inquiries into railway disasters Safe and successful organisations readily embrace and put into practice the principles of risk management as being a basic precept in the way that the strategic direction of the business is set.

This requires:

- Identification of hazards.
- Assessment of risks – frequency and consequence (severity) of any adverse outcomes.
- Establishment of tolerability levels.
- Discontinuation of any processes or practices presenting intolerable risks.
- Mitigation of minor and broadly tolerable risks at minimal cost.
- Setting of priorities for risk mitigation, taking cost and safety benefits into account.
- Comparison and contrasting of actual achievement against set targets and benchmarks.
- Establishment through communication and consultation of a "no blame" culture which will allow the safety problems of the organisation to be openly recognised and addressed. This is essential to achieve accurate "near miss" reporting.
- Monitoring for continuous improvement of the risk management process.

It is not good business to have high profile disasters Railways, which fail to successfully manage risk, although otherwise well managed organisations, can easily see themselves in considerable difficulty even though they may on the surface appear to be "quality" businesses.

Safe operation results mainly from the recognition and management of an organisation's risks and the control of human involvement in ensuring the carrying out of risky processes without error.

This paper has indicated an essential means by which the safety health of a railway may be assessed by comparison with others and through the setting of benchmarks for management action on inadequate risk controls to be prescribed.

It is very easy to become wise after the event and most certainly, in any circumstance, prevention must be far better than cure.

There is an old management adage, which says:

"If you can't measure - you can't manage"

It is also essential to be able to interpret the relevance of the measurements taken. They can be meaningless unless used in comparison with others and against acceptable benchmarks

The limited scale project conducted by the LTSA with a degree of informal encouragement from the delegates to the International Railway Safety Conference, has made good progress and the LTSA is happy to continue in the role of coordinator until it is replaced by something better.

It has already proved its value in New Zealand by being able to present comparative data to a formal Government Inquiry into railway safety.

It was somewhat disappointing not to have received contributions to this project from all delegates to the International Railway Safety Conference but it is recognised that in the short term not all can be focused on identical outcomes and views on priority must take precedence.

The on-going commitment for participating agencies will be to annually supply occurrence data and a range of statistical normalisers to the LTSA project. In return respondents will receive a series of league tables in each parameter indicating the normalised data ranges received from all contributions.

There is within the international railway industry a common view of the desirability to collect and exchange safety data. This has recently been recognised by a major project being set up by the International Union of Railways (UIC) which was due to commence in September 2000.

The LTSA has sought membership of the UIC to be part of the recently commenced database development project and will most certainly actively support the operation of an "official" comprehensive safety database to manage safety information internationally

The LTSA will be happy to be relieved of any future responsibility in the collection and dissemination of safety data once the UIC project is fully "up and running", has good industry support and becomes a source of comprehensive data.

9. ACKNOWLEDGEMENTS

The author's sincere thanks go to all of the organisations and people who have contributed to the compilation of the statistical data requested for this project.

The great amount of time and effort necessary to make a meaningful contribution is recognised and the LTSA of New Zealand wishes to formally acknowledge the value of these contributions.

The author also acknowledges the co-operation and assistance of Tranz Rail Ltd. as the major railway network operator in New Zealand in the preparation of this paper.

10. REFERENCES

"Railway Safety Benchmarking" A report prepared for the Land Transport Safety Authority of New Zealand ME Harvey, Consultant, June 1999.

"Railway Safety". HM Chief Inspector of Railways (UK) Annual Reports 1996/97 1997/98, 1998/99.

"Reducing Risks, Protecting People" Discussion Paper 1999. UK Health and Safety Inspectorate.

"Railroad Safety Statistics". USA Federal Railroad Administration Annual Reports 1997 and 1998.

"Railway Safety Regulation in Relation to Tolerable Risk and Best Practice Benchmarking". JT Atkinson. Paper to the 10th International Railway Safety Conference, Banff, Canada. October 1999.

"Management of Railway Safety through Best Practice Benchmarking of Performance" JT Atkinson, Paper to the RTSA Conference on Railway Engineering, Glenelg, South Australia. May 2000.

"Railway Safety: What is tolerable and how can we measure the safety health of an organisation?". JT Atkinson, Paper to the AIC Railsafe Conference, Sydney, Australia May 2000.

Table 1

Country Or Railway	Confidentiality Y:N	3	4	Lost Time Injury	5	6	7	8	9	10	11	12	13
RAIL	N/R NoRes	Tot Incids	Fat & SI	LTI	LC Incids	Derailmts	Coll'n	SPAD	Load Irrs	Dan Gds	Fire Fumes	Tech Fail'r	Van/ Sab
Can Nat	Y	X	X	X	X	X	X	X	N/A	X	N/A	X	N/A
Can Pac	Y	X	X	X	X	X	X	X	N/A	X	X	X	N/A
Via Rail	N/R												
Fed Can	N	X	X	N/A	X	X	X	X	X	X	X	X	X
Finland	N	N/A	X	N/A	X	X	X	N/A	N/A	N/A	X	N/A	N/A
France	N	N/A	X	N/A	X	X	X	N/A	N/A	N/A	N/A	N/A	N/A
Germany	N/R												
GB	N	X	X	N/A	X	X	X	X	Accs	N/A	X	X	X
Ireland	N/R												
Japan E	N	X	X	X	X	X	X	X	N/A	N/A	X	X	X
Japan	N	X	X	X	X	X	X	X	N/A	N/A	X	X	X
NSW	N	X	X	N/A	X	X	X	X	N/A	X	X	X	X
Nat R	Y	N/A	X	X	X	X	X	X	X	N/A	X	X	X
NZ	N	X	X	X	X	X	X	X	X		X	X	X
Norway	N	X	X	N/A	X	X	X	N/A	X	NIL	NIL	X	N/A
Qld	Y	X	X	N/A	X	X	X	X	X	X	X	N/A	N/A
Sth Afr	N	N	Y	N/A	X	X	X	N/A	N/A	N/A	N/A	N/A	N/A
Sweden	N	X	X	N/A	X	X	X	X	N/A	X	X	X	X
US-BNSF	N	X	X	X	X	X	X	X	N/A	X	N/A	N/A	N/A
US-CSX	N	X	X	N/A	X	X	X	N/A	N/A	X	N/A	N/A	N/A
US FRA	N	X	X	X	X	X	X	X	N/A	X	N/A	N/A	N/A
Victoria	N	N/A	X	N/A	X	N/A	N/A	X	X	X	N/A	X	N/A
WisconC	Y	X	X	X	X	X	X	X	X	NIL	NIL	X	X
METRO													
HongKong	Y	X	X	X	N/A	NIL	X	X	N/A	N/A	X	N/A	N/A
Lon U Ltd	N/R												
RATParis	Y	X	X	N/A	NIL	X	X	X	NIL	N/A	X	X	X
SA Metror	Y	X	X	N/A	X	X	X	X	NIL	NIL	X	X	X

NOTES X indicates response in this parameter. N/R indicates no response from invitee NIL indicates a zero return. N/A indicates not applicable or not available The FRA US and BNSF results have been extracted from the FRA annual Railroad Safety Statistics and may not present exact comparisons Finland data taken from "The Finnish Railway Statistics" from the the Internet

Table 2

Range of Results from 1999 Pilot Project

Safety parameters	Range of results	Mean	Units
Average total fatalities in accidents involving railways	10 – 1096 1.87 – 10.80 0.17 – 2.14	165 4.69 0.90	No. per annum Per million population Per million train kms
Rate	1 in 75,000 – 1 in 795,000	1 in 306,000	Whole population
Railway staff fatalities	0 – 6	5.2	No. per annum
Rate	Nil - 1 in 1,500	1 in 12,000	Staff population
Railway passenger fatalities	0 – 460 Nil – 0.72	35 0.42	No. per annum Billion pass. kms
Rate	Nil – 0.03 (1 in 33)	0.025 (1 in 40)	Million pass. journeys
No. of train collisions at level crossings	3 – 3,500 1.5 – 50 0.05 – 3.2 0.5 – 22	330 17.5 1.15 7.75	No. per annum Million registered motor vehicles Million train Kms Million population
No. of train/vehicle fatalities at level crossings	Nil – 450 Nil – 4.6 Nil – 0.41 Nil – 2.90	43 1.5 0.17 0.80	No. per annum Million registered motor vehicles Million train kms Million population
No. of train/pedestrian fatalities at level crossings	Nil – 69 0.01 - 0.11	15.50 0.040	No. per annum Million train kms
No. of fatalities – trespassers including suicides	6 – 510 0.10– 2.00	110 0.48	No. per annum Million train kms
No. of train collisions	1 – 220 0.004 – 1.90	38 0.24	No. per annum Million train kms
No. of running train derailments	6 –1770 0.01 – 9.75	172 3.15	No. per annum Million train kms
Signals passed at danger (SPADS)	8 – 660 0.03 – 6.20	130 1.5	No. per annum Million train kms

LTSA Benchmarking Project
Range of Results
1997-99

SAFETY PARAMETERS	1997 SAMPLE SIZE	1997 RANGE	1997 MEAN	1998 SAMPLE SIZE	1998 RANGE	1998 MEAN	1999 SAMPLE SIZE	1999 RANGE	1999 MEAN	UNITS
Total Safety Occurrences reported	20	40 – 16,700	3000	18	47 – 16500	3280	22	40 – 16,800	3000	No per annum
All reported occurrences notified to regulator	20	3 – 18,800	1920	18	2 – 10270	1720	22	1 – 1100	1480	Per 1000 Track Km
	20	0.97 - 153	34.20	18	0.73 - 148	34 70	22	0 86 - 100	28 68	Per million train Km
Total fatalities in accidents involving railways	22	4 – 1063	131	24	5 – 1008	126.30	24	3 – 930	112	No per annum
	22	0 30 – 12 10	4.10	24	0 22 – 13 60	3.87	24	0 34 – 11.20	3 40	Per million Population
	22	1 in 3,350,000 - 82630	1 in 590,750	24	1 in 4,447,000 - 216,000	1 in 652900	24	1 in 2,980,000 – 322,000	1 in 667,000	Total Population Rate (1 in X)
	22	0.11 – 6 99	1.01	24	0 08 – 5 53	0 89	23	0 05 – 4.26	0.74	Per million Train Kms
	15	0 16 – 16.39	4 57	16	0 21 – 18 20	3.55	18	0.11 – 16 03	2.84	Per million Gross Tonne Kms
Passenger fatalities	23	0 – 43	5 87	18	0 – 52	8 60	18	0 – 53	8.60	No per annum
	23	0 – 0.52	0 03	18	0 – 0 87	1 22	18	0 – 0 80	0 09	Per million passenger journeys
	17	0 – 2 19	0.15	18	0 – 2.24	0 16	18	0 – 1.65	0 11	Per million Train Kms
	17	0 - 1 665	0.50	18	0 - 56	3.75	18	0 - 32	2 18	Per billion passenger kms
Employee fatalities	23	0 – 43	5 43	18	0 – 32	3.67	24	0 – 42	4 04	No per annum
	23	0 – 56.41	11 14	18	0 - 16	7.1	24	0 - 47	10.75	Per 100,000 employees
Fatalities to Trespassers	22	0 – 533	77	15	1 – 536	111	24	2 - 572	78	No per annum
	22	0 – 2 47	0 42	15	0.10 – 2 03	0.62	24	0 12 – 1 00	0 41	Per million Train Kms
"Other" fatalities to public	23	0 – 144	11 35	18	1 – 150	18	24	0 – 145	11 00	No per annum
	23	0 – 2 19	0 12	18	0 01 – 2 24	0.18	24	0 – 0 96	0 09	Per million Train Kms
Total serious injuries in railway incidents	21	4 – 8400	667	24	4 – 7900	558	22	5 – 8413	645	No per annum
	21	0 90 – 54.10	15 90	24	0.76 – 107	13.80	22	0 98 – 106	15 30	Per million Population
	21	1 in 1,105,000 - 9,500	1 in 252,354	24	1 in 1,320,000 – 9,300	1 in 266,000	22	1 in 1,020,000 – 9420	1 in 239,400	Total Population
	21	0 10 – 21 5	4 00	24	0 07 – 9 54	3.50	22	0 11 – 17 46	4.14	Per million Train Kms
	15	0 20 – 24 76	5.79	18	0 15 – 19 54	4.90	13	0 18 – 18 42	5 07	Per million Gross Tonne Kms
Serious injuries to Passengers	17	2 - 628	118	24	0 – 622	79.20	19	0 – 614	103	No per annum
	17	0 02 – 2 58	0 37	16	0 – 1.22	0.26	18	0 – 1 17	0.27	Per million passenger journeys
	17	0 02 – 5 11	0 67	16	0 – 4 15	0 67	19	0 – 6 16	0 63	Per million Train Kms
	16	0 32 – 38 8	10 57	16	0 – 66	9.78	15	0 – 64	9 53	Per billion passenger kms
Serious Injuries to Employees	18	0 – 5371	379	21	0 – 5360	364	20	0 – 5779	408	No per annum
	17	0 – 6205	424	21	0 - 4290	675	20	0 - 4793	812	Per 100,000 employees
Serious Injuries to Trespassers	17	0 – 516	53 35	19	2 – 513	48	18	0 – 445	45	No per annum
	17	0 – 1 90	0.34	19	0 02 – 1.32	0 31	18	0 – 1 35	0 33	Per million Train Kms
"Other" serious injuries to public	17	0 – 363	48 12	18	0 – 216	38.75	18	0 – 312	39.30	No per annum
	17	0 – 4 20	0 64	18	0 – 2.57	0 31	18	0 – 3 46	0 58	Per million Train Kms
Equivalent Fatal Accident Rate. Fatalities plus (Serious Injuries)/10	22	4 40 – 1902	194	24	5 4 – 1800	182	24	4 10 – 1773	171	Rate
	22	0 60 – 23.00	5.29	24	0.80 – 23.00	5 77	24	0.32 – 33 25	6.42	Ratio
Ratio Serious Injuries to Fatalities	22	0 12 – 3 09	1 12	24	0 09 – 2 45	1.03	24	0 07 – 2 86	0.97	Per million Train Kms

SAFETY PARAMETERS	1997			1998			1999			UNITS
	SAMPLE SIZE	RANGE	MEAN	SAMPLE SIZE	RANGE	MEAN	SAMPLE SIZE	RANGE	MEAN	
Level Crossing(LC)/Train Collisions	21	0 – 3865	312	22	3 – 3508	274	22	3 – 3489	275	No per annum
	13	1 92 – 36.67	13 19	14	1 43 – 38 35	12 75	14	1 07 – 37.93	12 50	Collisions per 1000 crossings
	21	0 – 22 92	8.25	22	1 10 – 29 35	8 17	22	0.82 – 29.03	8 48	Collisions per million motor vehicles
	21	0 – 14.40	4 96	22	0 56 – 19.32	4 82	22	0.47 – 18 99	4.92	Per million population
	21	0 – 10 75	1 62	22	0 05 – 9.16	1.48	22	0 06 – 8.29	1.39	Per million Train Kms
	15	0 – 19 96	4 06	16	0 17 – 20.81	2 92	17	0.17 – 20 29	3 02	Per million Gross Tonne Kms
LC Train/Vehicle Fatalities	22	0 – 419	32 18	22	1 – 369	33.32	23	0 – 345	31.57	No per annum
	22	0 - 4.76	1.20	22	0 39 – 4 78	1.27	23	0 – 4.37	1 26	Rate per million motor vehicles
	22	0 – 2 16	0 69	22	0.11 – 2 16	0 69	23	0 – 2.66	0.66	Rate per million population
	22	0 – 0 47	0 16	22	0 004 – 0.50	0 16	23	0 – 0.57	0.02	Per million Train Kms
	15	0 – 1 85	0 53	16	0 05 – 3 10	0 61	17	0 – 3.27	0 56	Per million Gross Tonne Kms
Train/Pedestrian Fatalities at LC	20	0 – 95	9.45	22	0 – 67	9 00	21	0 – 62	9.33	No per annum
	20	0 – 0.07	0.03	21	0 – 0 07	0 03	21	0 – 0.12	0 03	Per million Train Kms
	13	0 – 3 80	0 35	14	0 – 2 92	0 28	17	0 – 2 57	0.27	Per million Gross Tonne Kms
Serious injuries at Level Crossings	19	0 – 1459	114	22	0 – 1303	80 55	16	0 – 41	14 81	No per annum
	19	0 – 5.45	1 43	21	0 4 87	0.88	16	0 – 2.13	0 95	Per million Population
	19	0 – 1.35	0 61	21	0 – 5 32	0.46	16	0 – 4.95	0 44	Per million Train Kms
	13	0 12 – 3.16	0.75	11	0 – 1 57	0 52	16	0 – 1 56	0 51	Per million Gross Tonne Kms
Derailments – Running Line	21	0 – 1741	141	19	0 – 1757	165	20	2 – 1961	164	No per annum
	21	0 – 4 35	0 84	19	0 – 4.57	0 98	20	0.003 – 3 56	0 84	Per million Train Kms
	9	0 – 8.72	3 43	13	0 05 – 9.28	2 27	8	0 02 – 9 15	3 66	Per million Gross Tonne Kms
Collisions	21	1 - 159	36	19	0 – 127	24	20	0 – 209	34	No per annum
	21	0 - 2.86	0.42	19	0 – 2 08	0.36	20	0 – 2 26	0 40	Per million Train Kms
	9	0 – 7 10	2 92	13	0 – 8.77	1 88	8	0 02 – 3 78	2 80	Per million Gross Tonne Kms
Signals Passed at Danger	21	3 – 690	72	13	1 – 642	85	20	2 – 666	57	No per annum
	16	0 05 – 11 70	5 18	13	0 02 – 11 53	3 80	13	0.04 – 15 00	3 86	Per million Train Kms
	16	0.004 – 4 02	0 80	13	0 01 – 1 48	0 82	13	0.003 – 2.90	0 08	Per million Gross Tonne Kms

International Rail Safety Conference

2000 LONDON

8 November - 10 November 2000
Forum Hotel, London, United Kingdom

Paper 0015

Tony West

What Factors Provide a Major Influence on the Performance of the Safety Critical Workforce

Publisher
2000 International Rail Safety Conference

International Rail Safety Conference

Tony West

Assistant General Secretary

ASLEF, UK

What Factors Provide a Major Influence on the Performance of the Safety Critical Workforce

International Railway Safety Conference 2000, The Forum, Hotel London 8-10 November 2000

Human Factors in Railway Safety

"What factors provide a major influence on the performance of the safety critical workforce?" - "The positive role of Trade Unions in promoting railway safety".

ASLEF believes that the Trade Unions have an essential role to play in promoting railway safety.

The Society is willing to work in partnership with employers, but a partnership has to be between equals.

We believe that the Trade Union movement can play a major role in enhancing safety in the rail industry. To that end we believe that the following are positive ways of achieving this common goal.

1. **Effective enforcement of current legislation**
2. **Power to issue Provisional Improvement Notices (PINS)**
3. **Greater protection against victimisation**
4. **Roving Safety Representatives**
5. **Increased training for Health & Safety Representatives/restoration of funding for TUC training.**

There is universal agreement that real progress in matters of workplace health and safety is impossible without the involvement, co-operation and commitment of all employees and their representatives. Yet in our experience, trained health & safety representatives in the railway industry is one of the employers's most under-valued and under-used resource.

Agreements exist with virtually all the main employers, which provide for the appointment of Union health & safety representatives in respect of the differing grade groups within each of the managerial boundaries.

These functions are based upon the rights established by the 1977 Safety Representatives and Safety Committees Regulations, particularly:

- the right to raise concerns on any health, safety or welfare issue
- the right to be consulted in good time on all matters which may affect the health, safety or welfare of those they represent
- the right to inspect the workplace, at least quarterly, and as part of an investigation into any accident or dangerous incident
- the right to be trained at a TUC or Trade Union approved course, within working time and at no cost to themselves
- the right to be allowed sufficient time away from normal duties to carry out their health and safety functions

However, the reality is that many of these rights are frequently ignored or denied.

HSC Discussion Document on Employee Consultation and involvement in health and safety at work

ASLEF responded to the HSC Discussion Document on Employee Consultation and involvement in health and safety at work Health and Safety Commission Discussion Document.

The Health and Safety Commission (HSC) recently launched a discussion exercise into workers' participation in health and safety at work. The HSC want to ensure that workers have more influence over managerial decision making, particularly small and medium sized enterprises. As such, the document is extremely important for trade unions. It is likely to impact on the future of trade union Safety Representatives.

Current Situation

The TUC and Trade Unions have been gathering evidence for some time, which shows that the most effective form of employee consultation is through trade union Safety Representatives. This evidence is supported by independent academic research, which shows that workplaces with trade union safety representatives have significantly lower accident rates than those without.

More recent European law placed a duty on every employer to consult with his or her employees in relation to health and safety matters. The UK implemented this law in the Health and Safety Consultation of Employees Regulations 1996. These Regulations apply to all workplaces where a union is not recognised and there are no trade union Safety Representatives (SR).

The Society believes that further measures should be introduced to promote greater workplace consultation and involvement in the workplace

Reasons for further measures

A major fear of the Society is that the government's efforts to be fair to business and enterprise threaten worker's health and safety, as employers tend to take this as a licence to continue killing and maiming workers in pursuit of bigger profits, economies or targets.

Despite the 1974 Health and Safety at Work Act and all the recent European inspired Regulations, 4 million workers each year suffer some form of work related ill-health, up to 3,000 are killed in incidents in connection with work and 20,000 die from occupational diseases. Penalties for Health & Safety breaches - even if they kill or maim workers - are still derisory. The rate of workplace inspections carried out by HSE Inspectors is now so low that, on average, companies can expect a visit only once in every 17 years.

The present government has begun to reverse some of the worst acts of the previous 18 years. Funding for the Health and Safety Executive (HSE) has been improved. HSE Inspectors have been reminded of the requirement to consult with safety representatives.

The requirement for Inspectors to advise employers in advance of the possibility of an Improvement Notice being served has been removed. The government has clearly stated that occupational safety and health is a priority and that penalties for offenders should be raised. New legislation for the offence of Corporate Killing is also being considered, which the Society fully support.

The government is very keen on partnership between trade unions and employers. The Society believes the only meaningful partnership that can deliver improved health and safety: a partnership of equals.

The government should assist the Society and the Trade Union movement to enhance and empower the trade union and workers side of the partnership and it must ensure employers compliance with all health and safety law through rigorous enforcement. The government's present philosophy of partnership is the existing abusive partnership that kills, maims and diseases millions annually.

The cost of industrial disease and serious injuries at work is not only borne by the victims; their families also pay a terrible price. The cost to the nation and the economy, just in terms of welfare benefits and the burdens placed on the NHS, runs to billions of pounds each year. By comparison, the sums awarded to victims in compensation are insignificant.

This Society Supports the Hazards Charter, which is radical in the sense that it points out that at the end of the 20th Century people in Britain are still dying from causes that could be stopped now with appropriate political will. We know the causes; we know what to do.

What is lacking is the resources and clear political will to take action. 1999 was the 25th anniversary of the Health and Safety at Work Act and the 21st anniversary of the Safety Representatives and Safety Committees Regulations. A great deal has changed in the last 25 years and the assumptions underlying the Health & Safety at Work Act no longer hold true.

The legislation does not fit easily with the enormous changes in employment patterns that have occurred since 1974. In 1999 we have a hugely increased number of workers in workplaces not represented by trade unions, mostly small, medium and even micro sized enterprises. We have seen an explosion of the "contract culture" – contracting out, out-sourcing, privatisation – an increase in 'self employment', in homeworking, the casualisation of large groups of peripheral workers through agency work and short term, temporary contracts.

The Society believes that this process of privatisation and casualisation has been to the determent of safety, especially in the railway industry. We now have a situation where Railtrack are using the armed forces to teach contractors railway discipline – discipline that used to be part of the overall safety culture of the industry but has been lost as a result of privatisation.

Enhanced role of the Safety Representative

The Society believes that the role of the Safety Representative should be enhanced and the main points are set out below:

1. Effective enforcement of current legislation

The Society also suggested to the HSC that effective enforcement of current legislation would improve health and safety standards. A more vigorous approach by the Health and Safety Executive to enforcing consultation rights will show employers that involving their workforce is not only effective but a legal requirement.

We have found that even if an agreement is reached at the highest level, it can be difficult to implement due to "operational reasons" at depot level. For example, "Driver shortages" can be used to cancel Depot level Health & Safety meetings at short notice, even though they may be arranged a year in advance.

ASLEF welcomes the now regular meetings with the HMRI, both at National and Regional level. We will be using these meetings to keep the HMRI informed of the problems that our Members face.

2. Power to issue Provisional Improvement Notices (PINS)

Adopted from an Australian system, Safety Representatives can place an improvement notice on their employer if they are ignoring health and safety hazards and members health and safety may be at risk.

The HSC are considering this, and would like to have pilot studies. This would involve training Safety Reps in how to issue PINS.

The TUC have set up a Working Party to examine how to introduce PINS, which the Society is involved in. The Working Party is producing guidance for SR's on how and when to issue PINS, a draft PIN and is working with experienced TUC Tutors to produce a training course for SR's. This would be used by all TUC tutors, and would also form the basis of Union/industry specific training.

For any pilot study to work, it would need companies to work with the HSC (HMRI) and the Trade Unions.

ASLEF suggests that a pilot study is set up within the railway industry, and RIAC have asked for a joint trade union paper on this subject.

2. Greater protection against victimisation

All workers are protected by employment law against dismal and suffering detriment for raising health and safety matters through employment tribunals. Safety Representatives have in rare circumstances been sacked for raising issues or for stopping jobs where they believe there are serious dangers. Unfortunately even if they win the tribunal and financial compensation there is no automatic right to reinstatement. We will be pressing for stronger protection for safety representatives and an automatic right to reinstatement.

3. Roving Safety Representatives

This would mean that trade union appointed safety representatives who have been specially trained can visit any workplace of different employers where members of their trade union work to represent them on health and safety matters. It would be an effective way of representing members who work for small and medium firms where there are few union members or where the union is not recognised. This also allows the most effective employee led safety initiative – trade union Safety Representatives – to be available for small businesses to improve their health and safety standards.

An evaluation of the roving safety representative's scheme in Sweden found that it had been successful in reducing injury rates in the transport industry and bakeries. The evaluation found that the scheme had also been welcomed by employers in the retail industry Many shop owners responded positively to roving safety representative's interventions saying it was good that somebody who knew the rules could advise them on what to do.

ASLEF suggests that Roving Safety Reps be piloted within the railway industry.

4. Increased training for Health & Safety Representatives/restoration of funding for TUC training

The Society has increasingly found it difficult to obtain the training, over and above Stage 1.

Even on EWS, where we have negotiated Stage 2, problems exist with the company not understanding the legislation. Just because a SR is training on Stage 2 does not mean they are not allowed to go to other, specific, training courses.

ASLEF are sending a Delegate to the Hazards 2000 conference, which has workshops for SR training. EWS have refused release both with and without pay.

The Society does not want to take companies to Employment Tribunals on this issue, and would rather come to an industry wide understanding on the need for training of SRs.

Some company's attitudes to SR training are that they want to grant the absolute minimum they believe they can get away with. They seem to appear to believe that SR training is a luxury, and that if it interferes with the service, then they can deny SRs - **it is not – it is a right.**

In a highly regulated industry, with high risk, Stage 1 training is just not enough.

Rama –v- SWT found in favour of a Safety Representative being given paid release to attend a Stage 2 course.

SRs should have the right to Stage 1, Stage 2 and other relevant H&S courses, especially when railway specific legislation is introduced or amended.

Another example is the how many SRs received specific training when the Railway (Safety Critical Work) Regulations were introduced?

Conclusion

As stated above, the Society is willing to work in partnership with employers, but this has to be on the basis of a partnership between equals.

ASLEF and the Trade Union movement have an essential role to play in promoting railway safety, and we believe that the measures below will assist in achieving this goal:

Effective enforcement of current legislation

Power to issue Provisional Improvement Notices (PINS)

Greater protection against victimisation

Roving Safety Representatives

Increased training for Health & Safety Representatives/restoration of funding for TUC training.

International Rail Safety Conference

2000 LONDON

8 November - 10 November 2000
Forum Hotel, London, United Kingdom

Paper 0016

Richard Rosser
Jon Allen

How do we gain and Maintain a Positive Safety Culture and How do we Measure It?

Publisher
2000 International Rail Safety Conference

International Rail Safety Conference

Richard Rosser

General Secretary and

John Allen Assistant General Secretary

TSSA, UK

How Do We Gain and Maintain a Positive Safety Culture and How Do We Measure It?

HOW DO WE GAIN AND MAINTAIN A POSITIVE SAFETY CULTURE AND HOW DO WE MEASURE IT?

Part: 1 (Jon Allen)

Defining 'safety culture'

- How do we define culture? - A nebulous idea

Culture is often defined as "*the assumption that within any society there are common goals and values which all members share*" (Dr. Charles Woolfson, July 2000). However, being a subjective concept 'culture' can have different meanings and interpretations to different people even if they belong to what is classified as an identifiable group.

"*Far from being universally agreed upon, definitions of reality in modern complex society are often a matter of fierce controversy and contest*" (Dr. Charles Woolfson, July 2000).

- Limited consensus on what a safety culture is or how it can be created

Two definitions

1. UK Advisory Committee on the Safety of Nuclear Installations (ACSNI Human Factors Study Group 1993 – Third Report: Organising for Safety)

"*The product of individual and group values, attitudes, perceptions, competencies, and patterns of behaviour that determine the commitment to, and the style and proficiency of, an organisation's health and safety management*"

2. Health & Safety Executive (Successful Health and Safety Management 1997)

"*The creation of a positive safety culture which secures involvement and participation at all levels*"

- Therefore any genuine workplace 'culture' cannot be imposed

- An effective, inclusive culture must be generated by the workforce in conjunction with visible senior management commitment

- Front-line, supervisory and middle management employees possess the unique knowledge that a company needs to truly understand the strengths and weaknesses of its operating procedures and systems i.e. 'bottom-up' safety auditing – what academics term the 'hidden transcript' (Dr. Charles Woolfson, July 2000)

- **A safety culture can only be created within, and operated by, an organisation that creates the conditions for genuine employee influence in the decision making processes that affect health and safety matters**

- Consequently, a safety culture will flourish best in a structure that is unified, does not exhibit adversarial relationships and exists within a stable and predictable environment of a safety partnership involving all stakeholders

Source: Dr. Charles Woolfson, July 2000

Safety Culture Criteria & Measurement

An organisation can be 'measured' against the following conditions

1. Employee involvement at all levels (including via their representatives) in the design and delivery of safety systems and procedures

2. A mechanism for confidential reporting and candid feedback

3. Shared & understood safety values & objectives

4. Safety objectives/procedures aligned to corporate incentives and strategy at the personal and strategic level i.e. KPIs, Job Descriptions, team plans, departmental plans and business plan

5. Visible safety commitment from the CEO and senior management

---

Part: 2 (Richard Rosser)

A Safety Culture within the UK railway context

The creation of separate Train Operating Companies, Infrastructure Maintenance Companies, Design and Signaling Companies and Rolling Stock Manufacturers and Leasing Companies and an infrastructure controller has generated:

1. New commercial, legal and regulatory disciplines

2. Fragmented responsibilities and new organisational arrangements with inconsistent messages about safety priorities

3. Companies that now have sharper conflicting commercial and operational interests and fewer incentives to co-operate together voluntary

4. Increasing reliance on sub-contractors, particularly for maintenance

5. Contractual relationships rather than a command structure – if it is not written down it may not be done

- Does this make the task of achieving a coherent safety culture more difficult?

- The DuPont Safety Resources report ("Safety Management in the Railway Group" - January 2000) commissioned by Railtrack's S & S D found that:

1. "There is no clear identification of safety leadership in the U.K. rail industry" (page 8)

2. "We found the general standard of workplace management to be low. Management at each level is not held accountable for safety behaviour of its people."

3. "The pre-eminent culture within the rail industry in the U.K. is one of focus on train performance in terms of delay. From our observations and interviews it became clear to DuPont that safety is sometimes subjugated to performance. The dominant figure of the Rail Regulator frequently reinforces the drive for train performance improvement. The leadership within Railtrack and the train operating companies does not at times achieve the correct balance on the ground between safety and train performance. There is little visibility of senior managers demonstrating the message that safety is a pre-requisite for train performance."

- Necessary Initiatives

1. To mitigate the consequences of a fragmented railway, improved industry inter-company and intra-company structures are needed that allow the genuine participation of the workforce and the trade unions that represent them in all health and safety matters

2. This will have two positive effects;

- One, it will encourage better communication and exploration of shared problems and adoption of common solutions.

- Two, it will help utilise the vital and unique knowledge that front-line, supervisory and middle management employees possess.

"The knowledge gained from front-line employees [is] invaluable" (DuPont, p. 9)

3. A matter of concern is that some operators frequently fail to consult safety representatives on the **preparation** of their Railway Safety Case (or revision of their safety case) as required by law. Often all that happens is that representatives on the Company Safety Committee are told when the safety case has been submitted or accepted, and sometimes given a copy upon request. This is at best retrospective and does not fulfil the legal obligation to consult prior to this process on the content of a safety case.

4. The effective operation of safety committees requires the following criteria to be met:

(i) Adequate numbers of safety reps/committees

(ii) Training received by safety reps, including risk assessment techniques, to allow them to assess work environments and risks accurately

(iii) Sufficient number and regularity of safety committee meetings which actually take place, together with the quality of the agenda in terms of the substantive matters discussed and whether there is a robust mechanism for monitoring and implementing agreed measures

(iv) Prompt circulation of minutes to all committee members which are then freely available to all affected staff, rather than just safety committee members

(v) Provision of adequate facilities for safety reps and sufficient time for them to discharge their health and safety duties, including liaison with their constituents and trade union contacts

(vi) Commitment of companies to safety committees and safety reps both in terms of the levels of management involved and how the work and role of safety committees are incorporated into corporate objectives, and

(vii) Confidential reporting on safety concerns in operation and regular health and safety surveys. Such reporting mechanisms and safety surveys should be undertaken in partnership with safety committees/unions and need to be independently conducted and reported on with confidentiality being maintained.

5. The unions also need to be self-critical and provide, where possible the resources to enable their officers and their members to utilise the wide consultative opportunities that the unions seek

Conclusion

Though defining, creating and measuring a 'safety culture' may be difficult, without creating the conditions at all levels of an organisation for genuine employee participation and representation it will be impossible.

International Rail Safety Conference

2000 LONDON

8 November - 10 November 2000
Forum Hotel, London, United Kingdom

Paper 0017

Tony Blyth

How do we gain and Maintain a Positive Safety Culture and How do we Measure It?

Publisher
2000 International Rail Safety Conference

International Rail Safety Conference

AG Blyth

Deputy Director, Safety

Eurotunnel, UK

How Do We Gain and Maintain a Positive Safety Culture and How Do We Measure It?

How do we Gain and Maintain a Positive Safety Culture and how do we Measure it?

by Tony Blyth
Deputy Director, Safety
Eurotunnel
November 2000

Much has been written recently as to the impact that a positive culture can have on the safety performance of an organisation. It seems clear that benefits arise not only in terms of safety but also on other aspects of organisational performance. This paper offers an overview of some of Eurotunnel's experiences in developing safety culture and of the benefits that the process has brought to the business.

Discussion

Safety culture cannot exist as a separate entity within an organisation, indeed it must exist as an integral part of the business along with other important aspects. One of the most important considerations therefore is how to introduce higher standards of safety into an organisation and how to develop a positive safety culture

Generally speaking, in many businesses there are three major management considerations Quality, Productivity and Costs. However world class organisations include a fourth consideration, safety, and ensure that equal importance is given to all four elements (Figure 1).

Figure 1

In such a system, management ensures that the importance of any one element is not permitted to become out of balance with the others since this can have a negative impact on the overall performance of a business The term *safety* used in this context implies

Safety, Health, and Environment and is coupled with awareness of the need to maintain morale and to gain the support of every employee in the organisation. Introducing this concept is an essential building block of culture.

In dealing with cultural issues, it is useful to have an appreciation of what is meant by the term culture. There are many ways to explain culture but my two favourites are

- *People's behaviour is a manifestation of their values, beliefs and the quality of their thinking*

or very simply

- *"It's the way we do things around here"*

If one accepts such statements, it is clearly important to any attempt to change a culture that efforts are made to influence the elements of our daily rituals that impact upon the way in which a group of people behave. I would argue strongly that influencing the way people behave by seeking to eliminate behavioural in-discipline, is a key strategic objective in any attempt to change culture. By way of example, one has only to consider the way in which 'drink drive' legislation has influenced the behaviour of most drivers towards alcohol consumption to understand that human behaviour can be altered. This idea can be further developed if we accept that in safety:

- *accidents and incidents are caused either by people doing something they should not do, or not doing something they should have done.*

or, alternatively

- *accidents and incidents are caused by the unsafe acts or omissions of people.*

As with any change process, the participation and support of management at the highest level is crucial to the success of the programme This is a particularly significant issue since culture evolves from the visible values of management In order to change a safety culture therefore, the values, beliefs and thought processes of senior management will need to be aligned towards a group of carefully established safety principles. Foremost amongst these principles is the concept that the visible commitment of management is essential to gaining and maintaining a good safety culture (Figure 2). Indeed without this element, all other initiatives and activities are likely to fail. I strongly believe that this process is the starting point for change and the engine for sustaining the change programme. Also, this stage is an essential precursor to modifying the behaviour of the entire organisation in terms of their habits and work rituals which will result in them becoming proactive in preventing accidents and incidents.

Figure 2

Gaining and Maintaining a Positive Safety Culture

Eurotunnel has developed a strong "Culture of Excellence". During the design and construction of the 'Tunnel' experts in railway technology and many other disciplines, including safety, were consulted and every facet of the project was the best it could be. The bi-national Intergovernmental Commission and the Safety Authority reinforced this excellence.

Eurotunnel had a stated "Safety Policy" from the outset. Before start-up, employees were trained and good safety practice was a part of that training. However, as employees who have been with Eurotunnel since the beginning agree, Eurotunnel was "like an army who had never been to war" – the fire in November 1996 changed that. The fire was the first practical test of the theory Eurotunnel undertook an in-depth inquiry and an independent report was published by the Safety Authority. It was clear to everyone at Eurotunnel that at the time of the fire the response and behaviour of people was paramount.

As a result, Eurotunnel undertook initiatives to achieve a "step change" in managing safety and contacted DuPont, a proven expert in this field. The audit by DuPont confirmed the excellence of the equipment and systems and confirmed our belief that there were weaknesses in the People segment and, in their opinion, this eroded the reliability of the System segment. As a result, a programme of continuous improvement was initiated and I set out the most significant of these below.

Management Training

One of the key recommendations arising out of the audit was to carry out management training in safety Early in 1998, Eurotunnel launched a series of training seminars for the entire senior and middle management team in which the principles of change and the importance of including safety in the daily business schedule of all managers was explained and debated. A senior executive director championed each seminar This process was later extended to supervisory level. These programmes were very successful and we are about to develop a second phase of the management programme to aid progress towards our long-term safety performance objectives. A key concept of the training was that the vast majority of accidents and incidents (more than 95%) are caused by the unsafe acts of people. To reduce the number of unsafe acts, it is necessary to positively influence the behaviour of people. Extracts taken from the management-training programme have been incorporated into our induction programme for all staff and contractors.

Safety Committee Structure

Cultural change requires the support of a high quality safety management system. We therefore reviewed our system of safety management and decided that, in addition to the committee structure in place at that time, new committees would be necessary to give focus to certain elements of our programme. A 'Central Safety Committee' was established, chaired by the Group Managing Director, to provide strategic focus and leadership to the way we manage safety. A 'People Safety Committee' was established to provide focus for the measures we implemented to influence human behaviour both of our staff and of our contractors. The existing committee, which dealt with the safety of commercial operations, was re-focused onto what we have termed 'System Safety Committee', giving guidance to management on systems policy and audit. This re-organisation of the committee structure has enabled us to make steady improvements to overall performance whilst providing information from which longer term strategic objectives could be devised.

Golden Safety Rules

We then established a set of 'Golden Safety Rules' These rules represent universal values, which we consider essential to promoting a good safety culture. They are:

If you are not trained or not sure, don't do it.
Report **ALL** accidents and incidents.
Respect **ALL** signals and speed limits.
Protect your worksite
Keep your workplace clean and tidy
Beware of moving vehicles and trains.
Wear your personal protective equipment
Don't cut corners - always follow procedures.

These rules were widely communicated to all employees, contractors and visitors. Each division was then invited to add a few extra rules specific to their activities and for application in their work areas. The promotion and implementation of these rules throughout the company has helped to establish some simple behavioural standards, which can be developed in the future.

Safety Walkabouts

The next element of our programme was to introduce regular visits by management to each workplace with the specific objective of engaging people in conversation about safety issues and seeking views on areas for improvement These so-called safety 'walkabouts' form an important element of our management's visible commitment to our principles and are now used by managers at all levels as a part of their daily routine. Safety walkabouts also provide managers with first hand data on the degree of compliance with overall values and the opportunity to observe working conditions and practices first hand. The value to cultural development of a visit to an area of our operation by a senior director focused solely on safety issues has been incalculable.

Setting Performance Objectives

Each year we establish performance objectives for safety, health and the environment. This process provides a framework for sustaining our safety culture through continuous improvement. Recently, we devised a programme of performance improvements to cover the next three years that we are able to do as a result of the understanding of our processes through monitoring developed over the past three years.

Sanctions

In order to ensure uniform treatment for breaches of our safety rules and principles, we have improved our conditions of employment to clarify the levels of sanction available to management.

Measuring Safety Culture

There are many views on the subject of measuring safety culture. We do not have specific measurement tools to measure culture, however, our system of monitoring tracks performance against targets and, by measuring overall performance, includes to some degree an element of cultural development.

Our system of monitoring currently covers three areas:

People Safety

- Lost Time Accident Frequency & Severity Rates
- Staff Surveys which include cultural issues
- Safe Working Index

System Safety

- Collective (or Societal) risk exposure
- Individual risk exposure

Overall Safety Index

- We are currently developing an overall safety index in which we seek to compare predicted performance with actual performance.

This group of performance measurements is also an important part of our overall package of monitoring activities in support of our Safety Case.

Other Benefits

Any programme of continuous development is likely to have 'spin-offs' which accrue to the business. In this regard, Eurotunnel's safety programme is certainly no exception First and foremost, we have learned how to make the best use of external expert advice and to inculcate this advice into our systems. We have also learned an enormous amount about our ability to adapt to change and to bring about change through 'leadership by example'. I suggest that any manager who develops the skills needed to create a positive safety culture will be able to transpose those same skills effectively into other areas of the business. We have developed previously untapped skills in setting performance improvement objectives driven by senior management and requiring the active participation of practically every level within the company and of our contractors.

In summary, gaining a positive safety culture is a practical objective for any organisation and its effects will be felt by many other parts of the business.

November 2000

International Rail Safety Conference

2000 LONDON

8 November - 10 November 2000
Forum Hotel, London, United Kingdom

Paper 0018

Susumu Chigira
Masakazu Takahashi

Building Up Safety Climate as Administrative Staff on Site

Publisher
2000 International Rail Safety Conference

International Rail Safety Conference

Susumu Chigira

Chairperson, Administrative & Supervisory Staff Section

and

Massa Takahahi

Director, Education Department

JREU, Japan

<u>Building Up a Safety Climate as Administrative Staff on Site</u>

Building up safety climate as administrative staff on site

by Susumu Chigira, East Japan Railway Workers' Union (JREU)

1. Introduction

I am the chief of the administrative staff section of JREU. Members of the section are administrative and supervisory staff at work sites, who work directly under local managers. Our main jobs are general administration, education and direction for employees at working places. Although we are supervisory staff, we are not part of management. We are colleagues of the people in the same administrative positions at work sites, organizing ourselves into the administrative staff section, a horizontal organization of the JREU machinery.
Because of the nature of our job we cannot avoid the issue of safety at working places. It is our crucial task to improve safety on sites because we work for a safety-critical industry. It is important to learn lessons by investigating railway accidents that have occurred, in order to prevent new accidents. We can take countermeasures to prevent similar accidents from happening when we analyze causes of accidents and grasp factors behind them. We at JREU named this stance as "determining cause rather than pursuing responsibility or blaming individual(s) ", and discussed it as a common ground with management at JR East to tackle accidents. We did not confine this stance only in our arena, but proposed it to the International Railway Safety Conference in Tokyo in 1990. The conference recognized the sprit as a global one. I think we must prize the stance and continue to hold it.

However, when I see situations in workplaces I wonder whether we have firmly established it and respect it as the corporate culture now. Blaming individual responsibilities for accidents does not decrease accidents. Taking workable preventive measures learned from analyzing true causes of accidents is the only way to decrease the number of accidents. Do we really apply this rule in practice? I as an administrative staff member am very skeptical about it.

Doesn't management face accidents in an inhumane way by thinking that accidents could be prevented by scaring workers with punishments? If it is, could people frankly tell the truth and the facts of accidents under such a situation? I rather doubt it

We were non-union members thirteen years ago because of a work rule in the Japanese National Railways period We have joined the union, JREU, after the privatization of JNR in 1987. However, I must admit that there are some fellow members at workplaces who still feel and remain distant from us because they think we are part of management, and that we control employees or union members with management's way of thinking. On the other hand, there are quite a number of our section members who stick to the management style of thinking. Some management also regards us as part of it. I would like to examine what we in administrative positions should do to enhance the safety climate at working places in such a situation.

2. A case study – signal passed at danger

In order to explore this issue, I would like to take an example, -- an accident of a signal passed at danger, of which administrative staff helped to determine causes and succeeded in tracing down the real cause.

On that day of the accident, the driver was ready in the driving cab of his train at the depot and was waiting for the shunting signal to clear. Then he saw the shunting signal turned to the proceed indication earlier than he had expected. Although wondering that "this is a little earlier", he started operating the train. Immediately afterwards when he drove his train into the open area of the depot building, blinding sunlight caught his eyes He adjusted his eyes at once and stared at the shunting signal again. Surprisingly the signal was indicating stop. He urgently tried to stop the train The train overran three meters past the shunting signal at danger The driver thought that this happened because a signalman at the station had urgently wanted to stop the train for some reason or other.

As this was a Signal Passed at Danger case, an in-house hearing of this accident was held with attendance of the driver and supervisors next day. The driver reiterated that the signal was "proceed" at first and changed afterwards. Since the supervisory and administrative staff of his depot also could not deny the possibility of a signalman's mistake, they decided to hold an on-site investigation

As a result of the on-site investigation, however, it was confirmed that there was no signal mistake on the station staff side. Many came to think that the driver had failed to recognize the stopping signal.

The local manager at the driver's depot held the hearing a second time. The manager told the driver that there had been no wrong operation by the station staff. He said to the driver, "Did you really see the proceed signal?" Others also joined and said " There have been many cases of failing to read a signal correctly" "As men are not machines, we could misunderstand or wrongly recognize things." "As the situation suggests, you failed to read the signal in this case, didn't you?" As many said so, the driver almost lost his confidence about the signal But he recovered soon and maintained his claim that it had been a proceed signal.

By that time management thought that the cause of the accident was nothing but driver's failure, considering the situation and investigation Some management even said that the driver was unqualified as a driver because he insisted he had seen the correct signal although it was not compatible with the facts

Some administrative staff of the depot, however, could not judge the case so easily. The hearing was held again. The administrative staff did not believe that he was lying because of such factors as the driver's maintenance of the argument, honest expression which showed eagerness for investigation of the causes, and especially when they heard his whisper to himself, "What was it, then?" Although the previous on-site investigation did not suggest any possibility of irregular reflection of light on the signal, they decided to carry out one more on-site investigation. The administrative staff as well as the driver could not feel it was proper to finish the case.

Shunting Signal System

- Stopping signal (this is the usual position for the signal)
  - The bottom right light is on
  - The bottom left light is always on

- Proceed signal
  - The upper light is on and
  - the bottom right light goes off.

It was a clear day next day, as on the day of the accident. The time of the investigation was also approximately the same A member of the administrative staff and a driver tried one way or another to see the signal from the driver's cab. Suddenly this driver cried out, "Look, all three lights of the shunting signal were on!" When the administrative staff saw the signal, the three lights were surely on. As you can see in the attached illustration, the three lights should not be on at one time. In either case, proceed or stop, only two lights of the three are on with different pairs. The two men got off the train and hurried to the signal to have a closer look. But they only found that two lights were correctly on, displaying a stopping signal. As they puzzled what they had seen from the driver's cab, they examined the signal closely. Then they discovered that there was a small checking hole in the back of the signal and the sunlight went directly through from the upper light, which creates an effect as if the upper light is on. The driver in question apparently had seen this light and started the train. They at last found that this was the case.

Of course there should be no three-light-on. Therefore, the driver should have confirmed whether the bottom right light was off before starting the train, even though he thought he saw the upper one was on. In this way, we could say that the driver failed to respond to the signal correctly, which is the way the driver himself now reflects upon it. However, it is psychologically natural that the driver was concentrating on the upper light of the signal as he was waiting for it to be on. Thus, we found the mechanism why the driver had seen an illusionary proceed signal.

3. Lessons from the Case -- to Build Safety Culture

Some might think that this was a very unusual case. However, accidents do happen under exceptional circumstances. We should learn from them universally.

One of the lessons we could learn from is the importance of telling the truth, which triggered the start of looking into causes. The driver maintained his argument that it had been a proceed signal, and was very sincere to tell the truth although his confidence had been shaken once. This sincerity led and encouraged the administrative staff to the path of seeking the truth. If administrative staff had regarded what he said as a lie, or if he had hidden the truth, or if they had not tried and could not reach the fact, similar kind of accident would have repeatedly happened. Then safety that is critical in our railway industry would be sadly deteriorated.

The second important lesson is that it resulted in fostering mutual confidence between administrative staff and their subordinates, because the administrative staff wanted and tried to respond to the driver's desire for the truth. Actually the driver said to the administrative staff, "You have believed me and succeeded to determine it this far. I really appreciate it." By believing his words, we could not only get to the bottom of this accident, but also make the safety culture take root in our working places, and shorten the distance within fellow members in our union. Which also shows that telling the truth is very important not only for analysis of accidents but also for a frank atmosphere at workplaces

A working place where workers can talk frankly what they think is the source of company vitalization Naturally it is the most substantial factor during the process of accident investigation.

We can take existence of mutual trust as a barometer to judge a workplace's health.

A company inevitably uses logic in its management of employees. Then why do they not manage our working places with trust? When company does not have a humane stance or respect human dignity, it is unattractive to workers and workers do not feel motivated. Only defiance would spread in such a company

We who work as administrative staff on site should not forget to endeavor to build such trust. If there are any members of management who try to control workplaces just with orders giving the company's way of thinking, our section is determined to challenge this

The third point I would like to make is the problem that some management intended to disqualify the driver. They said that the driver was unqualified for the job because he adamantly denied overlooking the stopping signal in the process of investigating causes. Such a judgement by management is a departure from the position that our union and management agreed to face accidents—"switch from pursuit of responsibility to determine cause". Management should take this as a serious lesson.

If we press workers hard to question the responsibility for accidents and incite their fear of telling the truth, we cannot get to the bottom. We can easily assume that such a way is a silly countermeasure for preventing accidents. Blaming individuals and punishment as its result only scares employees. It cannot let safety take root into our working places.

Telling the truth and hiding facts are opposites, but both exist in real life. Management who could ignore the fact that workers may hesitate to tell the truth outright should not participate in discussions for safety.

4. Conclusion

Intimidation and giving orders cannot foster safety climate at the workplace, nor workers' voluntary efforts for safety. Therefore management should recognize that ordering administrative staff to take intimidating measures or cause fright cannot build a willingness for a safety atmosphere at the floor. They should never consider strengthening such measures. Furthermore, they should not have a low evaluation of people who do not take such measures.

As I described, mutual trust is the premise of constructing a safety culture. I suppose it is obvious that labour and management could overcome any confrontation when they have mutual trust

We have to root our stance "determination of cause rather than pursuit of responsibility" deep into our workplaces as corporate culture. This should be our perspectives to tackle the safety issue.

International Rail Safety Conference

2000 LONDON

8 November - 10 November 2000
Forum Hotel, London, United Kingdom

Paper 0019

Jim Shultz

Co-Management of the Safety Process: How Labour Unions and Management are Working Together to Maximise Safety Improvements at CSX Transportation

Publisher
2000 International Rail Safety Conference

International Rail Safety Conference

James Schultz

Vice President & Chief Safety Officer

CSX Transportation, US

Co-Management of the Safety Process - How Labour Unions & Management are Working Together to Maximise Safety Improvements at CSX Transportation

RAIL SAFETY IN THE 21st CENTURY:

"HOW LABOR UNIONS AND MANAGEMENT ARE WORKING TOGETHER TO MAXIMIZE SAFETY AT CSX"

by

James T. Schultz
Vice President and Chief Safety Officer
CSX Transportation
Jacksonville, Florida

2000 International Railway Safety Conference
November 8-10, 2000
London, England

The Situation

The safety "bar" is being ra ... States. Despite an impressive record of improvement reduci ... es over the past 25 years, the industry faces an increasingly u ... ept rail accidents. The press, safety regulators, employees, customers, the citizens of communities we serve, and our management teams, have notched up safety expectations to higher levels than ever before.

CSX TRANSORTATION: LABOR and MANAGEMENT TOGETHER IN SAFETY

by James T. Schultz

2000 International Railway Safety Conference

CSXT safety improved dramatically in the late 1980's – mid 1990's. Collisions and injuries reduced almost 70 percent between 1985 and 1995. However, CSXT has been on a safety plateau since then, and the rate of continuing safety improvements has stagnated. The "low hanging fruit" and easy fixes are gone and improvements are slow in coming. Today, our challenges are different than before, with new technologies, increasing numbers of new employees in skilled craft positions, and managers struggling with what their role should be in a 21st Century world no longer open to a traditional "command and control" management style. It is obvious that we need to do something different if we are going to improve.

To change the trend, reduce risks and associated costs, and make a breakthrough to the next level in safety, we recognized that management driven safety programs, characteristic of CSXT in the 1990s, alone wouldn't foster the kind of break-through change we need to maximize safety. The missing element was the full support and ownership of safety by CSXT's rail labor unions and employees at all levels. If we ever want to achieve our goal of zero safety incidents and injuries, we need labor unions and CSXT management working together in a true safety partnership. That means every employee and every manager must be a champion for safe behaviors, and each mush share a sense of ownership for personal and co-worker safety.

CSX TRANSORTATION: LABOR and MANAGEMENT TOGETHER IN SAFETY

by James T. Schultz

2000 International Railway Safety Conference

How Do We Make It Happen.A Need for Change

Given the adversarial atmosphere that existed in the US rail industry between labor and management over the past 100 years, changing the relationship is a major undertaking. It requires a whole new paradigm all around, where command and control are replaced by trust and teamwork. Where managers relinquish some of their control, but not their leadership. Where employees are empowered and trusted to do the right thing when faced with a challenge. It its simplest terms, it is building a relationship based culture where the intellectual capital and loyalty of the workforce is leveraged to improve safety, service, and the bottom line. In late 1998, CSXT started that journey. We call it our "***Social Compact***."

CSXT's roots go back 173 years. Founded in 1827, our predecessor Baltimore and Ohio Railroad was the first common carrier railroad in the nation. Virtually since those very early days when America's first railroads were built, tension and mistrust have characterized labor-management relations in the industry. It isn't an easy road when you try to take a company rooted in the early 19th Century into the 21st Century as a high performing, new age organization. But it is a road we have to take given new safety and competitive pressures--that "bar" that keeps going up.

CSXT's Social Compact With Employees

What It Is, What It Means

The Social Compact with employees is a partnership between labor and management. It erases the us-versus-them attitude that characterized railroad labor/management relations in the past and replaces it with a corporate culture of teamwork and trust. The Social Compact encourages open communication and values the contributions of all employees. Most of all, it recognizes that labor and management must work together to create a safer, more customer-focused company that can continue to grow and provide rewarding jobs for its employees.

CSX TRANSORTATION: LABOR and MANAGEMENT
TOGETHER IN SAFETY
by James T. Schultz
2000 International Railway Safety Conference

How The Social Compact Works

The Social Compact is a philosophy of how labor and management interact at the grassroots level. It is not an organizational bureaucracy in Jacksonville, but it does have the support of the company's senior leadership. Here's how it works:

1. A corporate-level Culture Action Team that includes labor and management meets regularly to discuss ways that the Social Compact can be promoted and become stronger.

2. The culture team creates and protects an environment that allows managers and contract employees at the local level to work together toward common goals.

3. Local labor/management cooperation results in initiatives that create a safer workplace and a more efficient railroad.

What The Social Compact Does

- **Promotes safety.** Through the Social Compact, craft employees have taken ownership of safety programs. All of our labor unions own their safety programs. It is a developmental process, and individual accountability is the cornerstone. It gets to the behavioral aspect of safety, focusing less on "conditions" and more on at-risk behaviors and bad habits.

- **Improves service to customers.** Employees who provide the service participate in discussions and decisions about how service to customers can be improved.

- **Increases productivity.** The people who do the work are asked for their input about how the work can be done more efficiently, with less wasted effort.

- **Enhances quality of life.** Work/rest initiatives, scheduled trains and other initiatives create a more enjoyable work environment for employees and allow more quality time with families.

What The Social Compact Replaces

- **Inflexible decision making.** Labor and management listen to each other's concerns and problems, and they work together to find solutions.

- **Finger pointing and accusations.** When the team fails, everybody fails. Energy that once went into assigning blame now goes into solving problems.

- **Harsh discipline and punishment.** Rules infractions are serious concerns, but a response that corrects dangerous behavior is far more effective than harsh punishment that creates lasting animosity and discourages improvement.

Culture Change 101: A Case Study

A look at CSXT's Central Region where employees at all levels have embraced the culture change and are making it work for themselves and their customers

The Central Region is one of CSXT's five operating regions. Headquartered in Huntington, West Virginia, it extends into Ohio, Pennsylvania, Maryland, Virginia, Kentucky, and Tennessee. It is at the core of the CSXT network, and includes the vast majority of CSXT served coal fields.

When the Social Compact became CSXT's guiding philosophy in 1998, employees on the Central Region quickly recognized aspects of the concept. That's because they already had begun implementing many of the principles that comprise the Compact. The Central Region was among the first on the railroad to embrace the philosophy that open communication between labor and management is the key to success in everything from safety to service. The leadership set the tone for the region through an on-going series of "Let's Talk" meetings that took place regularly at virtually every location where employees report to work, on all shifts.

CSX TRANSORTATION: LABOR and MANAGEMENT TOGETHER IN SAFETY

by James T. Schultz
2000 International Railway Safety Conference

Face-to-face dialogue

A core activity of the culture change that has taken place in the Central Region is frequent communication between managers, the local union chairmen and safety committees. Working as teams, they identify ways to improve safety, cost efficiency and service.

The initiatives vary from location to location because each location is unique. Who knows better how to do the work than the people who do the work? Strong managers are important because they encourage teamwork and help keep people focused on the big picture, but the best ideas for improving day-to-day operations come from the employees who do the work. Labor/management discussions have produced many improvements in the region.

New hire mentoring

A new-hire mentoring program that started several years ago is one success story. The program for train and engine employees gives new hires an opportunity to go to mentors in their craft to ask questions that they might not feel comfortable asking managers.

In addition, new employees are given additional on-the-job training to supplement what they receive in their normal training programs.

The mentoring program, suggested and run by union employees, has worked so well that the region has begun a mentoring program for new managers by senior union employees to help them acclimate to their jobs more effectively. The region also has used its labor/management dialogue to identify opportunities to provide a better quality of life for employees.

Work/rest initiatives

At Shelby, Kentucky, road switcher crews serving the area mines have a scheduled five-days-on/two-days-off work week, so they know well in advance when they will have days off.

In addition to allowing employees to be more rested and plan family activities, the work-rest initiative has reduced overtime costs and improved service to the mines. Service has been so reliable that the mines have adjusted production to match the crews' work schedules.

A similar work-rest initiative is now underway for crews running between Russell, Kentucky and Columbus, Ohio. In that initiative, crews are working eight days and taking off three.

And the region's quality-of-life considerations don't apply to contract employees only. An initiative begun on the Central Region and now being rolled out system wide encourages managers to take two days off per week. It makes their jobs less stressful and makes them more effective when they're working.

Discipline policy working

Also not to be overlooked has been the importance of the railroad's Individual Development and Personal Accountability Policy, which has worked in conjunction with all of the other Central Region initiatives to create a highly visible and much-appreciated change in the labor/management relationship.

Says one local union official: "We're proving that you can have a strong union and work with strong management to produce a strong product."

Safety Results

Obviously, the ultimate measure of success is in the results. In this area, the Central Region comes out on top. The region swept internal CSXT safety awards in all categories: Lowest injury frequency, lowest train accident frequency, and best managed train accident prevention program. The Central Region team is proving that collaborative, trust based teamwork, is the way to win in safety and service. It serves as the model for the entire CSXT system.

Other Social Compact Successes

Highlights From The Past Two Years

- The cornerstone for CSXT's culture change was laid in July 1998, when labor and management approved a new non-punitive discipline policy, setting a new course for the rail industry.

- The CSXT Culture Action Team has become the social conscience of the railroad, providing guidance and oversight for the culture training process. The team addresses issues such as safety, customer service, payroll and work/rest.

- A complete restructuring of the railroad's safety department in 1999 created five regional director positions to extend the safety and culture change process into the field.

- The confidence and trust established through the Social Compact was a major positive force during the Conrail integration in 1999. Labor and management worked together during the integration to solve problems in key areas such as taxi scheduling for crews, customer service, payroll, crew availability and train operations.

- Continuing a process that began with the Conrail integration, labor and management maintain close communication through biweekly conference calls that encourage honest, open discussion and problem solving.

- Union-represented craft employees all across the railroad have demonstrated overwhelming support for the process of culture change.

- Work/rest programs in Ohio, Virginia, North Carolina, Kentucky and West Virginia allow crews to forecast days off months in advance, which improves quality of life as well as safety, because crews are better rested when the come to work.

- The SENSE Program, developed and run by the Brotherhood of Locomotive Engineers, continues to prove its worth by reducing engineer injuries.

- The United Transportation Union's Safety Model Program provides for union management of safety processes and has the total support of railroad management.

CSX TRANSORTATION: LABOR and MANAGEMENT TOGETHER IN SAFETY

by James T. Schultz

2000 International Railway Safety Conference

- Ideas proposed by union-represented employees on the Florida Business Unit helped improve service to Tropicana, which reduced juice-train cycle times and increased business.

- Labor and management worked together on service initiatives in the Midwest Region that that helped reduce average call dwell in Cincinnati's Queensgate terminal by 30 percent. At the same time, the initiatives enabled employees to spend less time away from home.

- A railroad-wide policy of business casual dress for managers was established to eliminate perceived class distinction between managers and craft employees.

- The operational testing program was revised through a cooperative effort of labor organizations, the Federal Railroad Administration and CSXT.

- Rail labor was given a voice in the selection of employees for certain management promotions and positions.

- CSXT participated in the AFL/CIO conference for the first time in 1999, and again in 2000. The railroad believes the trade fair is an excellent opportunity to spread the message of its new Social Compact.

- The CSXT Social Compact has become a model for labor-management partnership. It was presented to rail Unions and rail companies across America and Canada in 1999 and 2000, as well as other organizations.

CSX TRANSORTATION: LABOR and MANAGEMENT
TOGETHER IN SAFETY
by James T. Schultz
2000 International Railway Safety Conference

Our Guidance to Managers—How to Make The Change in Leadership Style

As railroaders, we have much to be proud of. We are part of an industry that helped build America, and continues to provide the United States' most economical and environmentally sound freight transportation. Yet there is one aspect of our history in which we take no pride. That is the animosity and distrust that has characterized the railroad labor/management relationship for more than 170 years. The time to change that legacy is now, and the railroad leading the change is CSX Transportation.

Why Now?

There are many compelling reasons why management and labor at CSXT are putting aside the adversarial relationship of the past. One is that it's simply the right thing to do. We have grown as a society to recognize that we can all make valuable contributions, and each one of us deserves respect for the job we do — and a safe work environment in which to do it.

In addition, a strong business case can be made for our Social Compact with employees. Since many of the regulations that handcuffed the industry were removed 20 years ago, we have regained the profitability that was absent in the dismal era of railroad failures and near failures. So far, however, much of the recovery has been built on productivity improvements — by the ability to dispose of non-profitable lines and operate trains with fewer people. We have not yet demonstrated an ability to make large inroads into the intercity freight marketshare of trucks and grow beyond the rate of economic expansion.

One reason for our stagnation is our ongoing struggle to substantially improve service — and that goes to the heart of why a culture change became imperative to the future of our company.

CSX TRANSORTATION: LABOR and MANAGEMENT
TOGETHER IN SAFETY
by James T. Schultz
2000 International Railway Safety Conference

How The Social Compact Will Help Us Grow

At CSXT, we have recognized that without a fundamental change in the way management and labor relate to each other — a change in the corporate culture — our railroad could never hope to provide customers with the level of service they require to give us substantially more business.

On the other hand, when labor and management cooperate to find solutions to improving safety, service and performance, we can position ourselves for tremendous growth. Our customers tell us repeatedly that they want to put more traffic on our railroad. In general, they like our economics much better than those of trucks. But they are skeptical that we can handle additional business effectively.

The Social Compact can restore our customers' confidence in our service by directly impacting our ability to achieve the goals we have set in our safety and performance measurements. These goals can be achieved only if our employees are willing to give us 100 percent effort every day, and they will give us that effort only if we demonstrate to them that that we value their contributions and respect the work they do.

Now Is The Time For Strong Leadership—A Manager's Guide to the Social Compact

The Social Compact is about empowerment of employees and relinquishing a certain amount of managerial control. It is not, however, about relinquishing leadership. More than ever, our managers must be strong leaders who build consensus and motivate employees to accept responsibility — and accountability. To be successful in the new railroad culture, a manager must:

- **Delegate responsibility, not abdicate it.** Through labor-run safety programs and labor/management service initiatives, employees must feel that they can make decisions that improve safety or better serve our customers without worrying that they are going to be second-guessed at every turn. But managers still coach the team. A leader's role is to make sure employees understand the goals, to give them the right tools, and to redirect them if they drift off course.

- **Be a visible presence.** Managers must spend more time talking to employees where they work. Respond honestly to questions, ask their concerns, and make it a point to follow up on those concerns.

- **Teach employees to be self managers.** It's impossible to monitor every employee at all times. A crew operating a train worth millions of dollars in freight and equipment is largely on its own once it leaves the terminal. Help employees understand the magnitude of their responsibility. Let them know you're always available to provide support and advice, but trust them to make the right decisions.

- **Talk about the business.** Our employees are business savvy, and they want to help our company succeed. Explain to them the rationale for our company's business decisions and how their actions have a direct impact on our performance. For example, every one-mile-per-hour increase in network train velocity is worth 75 locomotives; and every one-hour decrease in car dwell in terminals is worth 1,000 freight cars. Look for specific examples locally that people can relate to.

- **Maintain vigilance on rules infractions.** The Individual Development and Personal Accountability Policy emphasizes correcting unsafe behavior, not ignoring it. Managers still have the responsibility to intervene when an employee consistently threatens the health and safety of themselves or others.

- **Be hard on facts, soft on people.** Most people are conscientious and eager to contribute. Motivate them by focusing on areas that must be improved and support your positions with facts. You will never achieve lasting improvement by blaming individuals and chastising them personally.

- **Be a champion of change, not an impediment.** You can't lead from the back of the pack. The Social Compact is here to stay, so get out in front and make it work.

CSX TRANSORTATION: LABOR and MANAGEMENT
TOGETHER IN SAFETY
by James T. Schultz
2000 International Railway Safety Conference

The Last Word...

In the immediate aftermath of CST's acquisition of part of former Conrail, the value of the Social Compact was clearly evident. Labor worked hand in hand with management to keep the network fluid, and we handled the change better than anyone anticipated. Nevertheless, there are some that continue to surmise that traditional command-and-control style of management is the best way to win in the end. But that is a flawed — and dangerous — view. The culture change we have undertaken is monumental. It is reversing 170 years of history, and there will be times when it's difficult to see tangible success. But, while command-and-control management might allow a railroad to continue to grow at 2 percent to 3 percent per year, it will never enable us to achieve the level of service improvement that will begin to divert large volumes of freight from the highways.

To provide that level of service, and to achieve double digit growth, we must have the total support and commitment of all employees. We *cannot* win that support by treating employees like children who can't be trusted and must be punished for making even minor mistakes. We *can* win that support by becoming partners with our employees, by correcting unsafe behaviors through coaching and education, and by understanding that we're all in this together. Only by working together can we secure our future and make CSXT the best railroad in America.

The process has not been without challenges and we continue to grow and learn as the program evolves. Some of the challenges in implementing this "change" include:

- one size doesn't fit all.each craft union may require variations in program structure and implementation.management must be flexible and open.
- that managers don't abdicate their leadership role.they must coach and support the union effort and trust employees to make the right decisions
- gaining labor union leadership support in accepting accountability for safety performance of the union membership
- that both union and management leaders understand their shared responsibility and accountability for ensuring safe behaviors and rules compliance

- recognizing that initially the statistics may spike as employees report incidents that may have been suppressed under earlier "command and control" environments

We at CSXT believe that ultimately it is the grassroots employee buy-in and individual acceptance of responsibility for safety performance that will allow quantum change in safety performance. That grassroots buy-in can only come if there is a culture of trust between labor and management. CSXT is moving in earnest to change our culture to make it possible to achieve maximum safety. It includes developing ways to reward safety advocacy--the foundation of healthy culture and a tenant of CSXT's new social compact.

Success is the best remedy for rough spots brought about by change.with implementation of our proactive intervention in safety culture today, the changes will succeed because it will be met by a safety culture that has established parameters and full management and labor leader commitment.

##

Enclosure

Paper by: *James T. Schultz*
Vice President and Chief Safety Officer
CSX Transportation
500 Water Street
Jacksonville, Florida 32202 USA
(904) 359-1977
(904) 359-3763 (facsimile)

November 2000

International Rail Safety Conference

2000 LONDON

8 November - 10 November 2000
Forum Hotel, London, United Kingdom

Paper 0020

Gerard Boqueho
Yves Mortureux

Evolution of the Regulatory Framework Governing the Relations between the State and the Various Players Involved in Safety Management on the French National Railway Network

Publisher
2000 International Rail Safety Conference

International Rail Safety Conference

Gerald Boqueho,

Division Chief &

Yves Mortureux

SNCF

Evolution of the Regulatory Framework Governing the Relations between the State and the Varying Players Involved in Safety Management on the French National Railway Network

DEPARTEMENT SYSTEMES D'EXPLOITATION ET SECURITE
(Operating Systems and Safety Department)
17 RUE D'AMSTERDAM
75008 PARIS

Matter being handled by: Roger Ducottet

THE DECREE OF 3O MARCH 2000 ON THE SAFETY OF THE FRENCH NATIONAL RAILWAY NETWORK

The main intent of the decree on the safety of the national railway network published on the 30th of March 2000 was:

- to replace the provisions of a technical nature set down in the decree of 22 March 1942, which had become broadly out of date,
- to obtain and uphold a high standard of safety on the national rail network, in particular by applying methods already proven in the field of dependability and quality (with dependability understood to mean reliability, availability, maintainability *and safety*),
- to clarify the duties that incumb upon the various parties in the railway system in light of the structural evolutions that have followed the European policy guidelines, namely the creation of the French infrastructure owner, RFF, and the appearance of new entities such as Infrastructure Managers (IMs) and Railway Undertakings (RUs).

1. GUIDING PRINCIPLES

1.1 Systems approach

The decree takes a systems approach to rail transport, appreciating the railway system as a set of interdependent, integrated elements. The elements are the human operators, the equipment, the regulations and procedures and the environment.

SNCF is explicitly designated in the decree as the architect in charge of guaranteeing that the union and combination of these elements from the organisational and functional standpoints is such as to continually ensure compliance with the level of safety demanded by society.

1.2 A "new approach"

Safety does not result from the mere piling up of resources. The safety guidelines state the needs in terms of objectives to be attained, of results, of "essential requirements" and of methods and rules of the art (codes of practice) to be followed to assess a system's conformity and fitness for use.

1.3 Affirmation of a principle called GAME

The decree advocates the principle that a system must be "at least globally equivalent" (or G.A.M E., for "*Globalement au moins équivalent*" in French) to the one that existed before, which is akin to "As Low As Reasonably Practicable" (ALARP) concept in risk management.

1.3.1 Statement of the principle

"The modification of an existing system as well as the design and implementation of a new system shall be made in such manner that the overall level of safety that results is at least equivalent to the existing level of safety or to that of existing systems providing comparable services or functions." (Article 3 of the Decree)

1.3.2 Choice of the reference system

The comparison is made primarily between the new or modified system and the existing railway system (reference system), but application of the G-A-M-E principle does not prevent taking other transport systems *(providing comparable services or functions)* as the reference, if that choice is duly documented and proven to be relevant.

1.3.3 Evaluation of the level of safety

The safety level of the existing system is presumed to be satisfactory. The G-A-M-E principle admonishes against any regression in safety by a new or modified system, but it does not make it compulsory to improve the level.

The upholding of that level and, *a fortiori,* any possible improvement to it must be appreciated in a holistic way (which is where the "globally" comes in): the assessment must be made on the basis, not of a specific hazard considered in isolation, but rather on the whole set of risks dealt with by the new or modified system. The system designer is free to make the safety apportionments for the risks handled as he sees fit, provided he demonstrates that, on the whole, the reference level of safety is upheld.

The G-A-M-E principle does not entail the use of one or more predetermined methods to establish that the level of safety is achieved. However, thought is being given to the various different ways of making the case. Ultimately, these will be addressed in a Ministerial Order

2. PROVISIONS REGARDING SYSTEM DEFINITION AND DESIGN

The process described below must be followed whenever any element of the infrastructure, rolling stock, command/control or other system is modified and, obviously, for every new system

2.1 Project definition

The project must be presented in a project definition file (*dossier de définition*).

The definition package is drawn up by the promoter (*promoteur*), i.e. the developer, owner, client or "engineer" (*maître d'ouvrage*). The promoter is usually RFF where the infrastructure is concerned and SNCF, as passenger and freight Railway Undertaking, where rolling stock is concerned. Other promoters may be rolling stock owners for example, who wish to register a new type of wagon.

The file is sent to the Ministry of Transport, which responds with remarks on the safety issues involved.

The file presents "the main technical and functional characteristics of the project and the elements supporting the safety objectives".

2.2 Preliminary safety case

Clearance for the project is subordinated to the acceptance, by the Minister of Transport, of a preliminary safety case (*dossier préliminaire de sécurité – DPS*).

This *dossier* is the key part of the procedure. It is drawn up by SNCF on the basis of the project definition package, irrespective of the promoter concerned, and is then forwarded to RFF for an opinion.

The purpose of the DPS is to formalise, detail and quantify the safety objectives chosen, the means of achieving them and upholding them over time and the associated means of proof.

3. PROVISIONS REGARDING SYSTEM IMPLEMENTATION

3.1 Safety Case

At the end of the project implementation phase, the procedure makes it incumbent upon SNCF to demonstrate by means of a safety case (*dossier de sécurité – DS*) compliance with the "essential requirements" and the provisions of the DPS.

The purpose of the DS is threefold:

- to describe the system implemented and specify its scope,
- to establish that the safety objectives have been met with the help of the means specified in the DPS,
- to formalise the undertakings and commitments necessary for system operation.

The Safety Case (DS) is likewise drawn up by SNCF and is then submitted to the Minister of Transport for approval, accompanied by RFF's opinion.

3.2 The independent technical body or bureau

Furthermore, conformity of system implementation with the provisions of the DPS is also verified by a body or bureau that is independent of both the designers and builders, which checks, among other things, that the design and implementation conform to the standards in force and the rules of the art.

This requirement is a new and fundamental one in the process of finalising a new or modified system.

3.3 Authorisation to operate

The permission to put the system into operation is granted by the Minister of Transport on the basis of the following items:

- the DS (Safety Case), which must *inter alia* specify the principles of system maintenance and the ways and means of training the personnel,
- when relevant, the modifications to the Operating Safety Rules made necessary by the project.

4. PROVISIONS REGARDING SYSTEM OPERATION

In addition to the provisions discussed above concerning the finalisation of a new or modified system, operating safety depends on conditions relating to personnel and regulations:

- for personnel, the decree institutes requirements for screening, training and qualifying staff with safety-related duties;
- with regard to safety regulations, the decree makes it a requirement that there be an Operating Safety Regulation approved by the Minister of Transport, supplemented by operating guidelines and maintenance rules.

Actual operation of the system is addressed by the following measures:

- a monitoring sscheme consisting of internal checks by the operator and of safety audits,
- an information feedback system consisting of a record of the main safety-related events, which the operator reports to SNCF,
- annual safety reports made by SNCF and RFF to the Minister of Transport,
- an action plan for intervention by SNCF and for notifying government and judicial authorities in the event of a serious incident or an accident,
- measures decided by the Minister of Transport for stopping or suspending operation in the event of a serious system dysfunctioning affecting safety and, if necessary, precautionary measures taken by SNCF.

--*

The approach taken in the decree on the safety of the national railway network takes account of the most modern principles and methods of safety management used in the industrial sectors, such as chemistry, aeronautics and nuclear energy, to which society applies the toughest standards.

But against the risk of dispersion and dilution of responsibilities that could arise due to the organisational changes taking place in railway transport, the role of integrating safety-related aspects at each stage of the railway system's life cycle has been officially assigned to SNCF.

2000 LONDON

8 November - 10 November 2000
Forum Hotel, London, United Kingdom

Paper 0021

Takeshi Inoue
Yashuiro Suzuki

Technical Deregulation about Railway Enterprise in Japan

Publisher
2000 International Rail Safety Conference

International Rail Safety Conference

Takeshi Inoue, Executive Director

Yasuhiro Suzuki, Transport Safety Department Assistant Manager &

Yutaka Hasegawa, Transport Safety Department Manager

JREU, Japan

Technical Deregulation about Railway Enterprise in Japan

2000 INTERNATIONAL RAILWAY SAFETY CONFERENCE

November 8-10,2000

LONDON

Technical deregulation about railway enterprises in Japan

Mr. Takeshi Inoue -Executive director-
Mr. Yutaka Hasegawa -Transport Safety Department Manager-
Mr. Yasuhiro Suzuki -Transport Safety Department Assistant Manager-

EAST JAPAN RAILWAY COMPANY, JAPAN

Technical deregulation about railway enterprises in Japan

Our government has decided that administrative reform will be aimed at a free and fair economic structure that stands on the principle of self-responsibility and the market mechanism and therefore that will be open internationally.

□The basic policy is " What is made by the people is left to the private sector. " So, the Ministry of Transportation (MOT) duties will be minimized, and the need will be for converting to a post-checking type from a prior regulation type. Planing has started and will be carried out.
□In such a situation, specialists who are persons of learning and experience and railway enterprises are promoting the following recommendations.

1. Technical Regulation System

The technical regulation of a railway enterprise is divided into regulation of operations and procedures, and the regulation of technical standards.

(1) Regulation of operations and procedures

When a railway enterprise will change railway construction, vehicles, operation plan or an enterprise's master plan, it has to report those plans. Law, ministerial ordinance and notification have set this procedure.

About this regulation, although all railway enterprises are targeted uniformly now, it is recommended that simplified regulations and procedures be applied to large railway enterprises with high-level technical capabilities.

(2) Regulation of technical standards

Standards for facilities, train handling and operation, etc., have been set by five ministerial ordinances that specify of structure rules, operation rules, etc. from the viewpoint of planning safety of transportation.

Numerical values and specifications are defined in detail concretely now and there are 812 articles based on these five ministerial ordinances. It is suggested that only 131 articles specify the required performance from now on. (See Separate sheet 1)

2. Railway enterprises in Japan

(1) The number of railway enterprises in Japan

There are 208 railway enterprises in our country. The passenger line networks are about 27,000km. Of this, we have about 7,000km, or about 1/4 of the entire passenger line network of our country.

(See Separate sheet 2)

(2) The number of railway accidents in Japan

The number of railway accidents in our country was 1456 in 1987. In the most recent fiscal year, it was 927, and it is decreasing consistently. Also, in our company, the number was 376 at the time our company started, and has decreased to 142 in the most recent fiscal year. Calculated as the number of cases per million train-km, it is 0.53 now and has decreased to 1/3 as compared with 1987.

For a railway enterprise to prevent accidents, it must take the lead and have devised safety measures. When a safety measure is violated, even when it did not result in an accident, it is an incident that could have caused trouble in operation of a train, and this number is increasing.

(See Separate sheet 3)

3. Problem of Present Technical Regulation

(1) The system of the railway enterprise regulation before the JNR(Japanese National Railways) reform in 1987 had been divided into the regulation of private railways and of JNR.

There were large gaps in technical capabilities in private railway enterprises because some of them are enterprises of a small scale. Therefore, the MOT had been considered as the organization that carried out regulation supervision directly. Since JNR had been called a government organization, the MOT had performed neither direct regulation nor intervention, but these matters had been left to the self-responsibility of JNR. However, the MOT had decided that regulation should apply to the Japan Railways group companies into which JNR had been divided, which were also determined to be private railways after the JNR reform. Procedures such as approval and notification are required by the MOT for matters on which the Japan Railways group companies, including our company, could be managed with an internal procedure in the JNR time. From that cause, the amount of duties had increased sharply.

(2) Technical regulations in Japan are provided for many things. For example, regulations say " A roof should be metallic plate. " " A windowpane should be safety glass. " So we cannot use new materials that have equivalent performance, such as nonflammable reinforced plastic and safety glass that is lighter than metal, since there are such regulations. So we can respond neither to change in the social economy situation in recent years nor to the fast progress that has come on the technical side.

4. View and Progress of Technical Deregulation

(1) The prior regulation system according to technical capability

The MOT examined in advance whether a railway enterprise would have enough technical capability to ensure safety, and introduced the system of performing prior regulation at the necessary minimum according to this technical capability. This system is named the authorized enterprise system.

1) Technical Power Which Authorized Enterprises Should Have

The MOT examines and verifies that an enterprise has an adequate level of organization, not simply an individual engineer but an enterprise that designs railway construction and vehicles and is complete to determine that the organization is ready to be authorized.

(See Separate sheet 4)

2) Regulation of an Authorized Enterprise

For the materials standards, such as structures, that are indicated in the technical standard, an authorized enterprise checks itself and itself takes responsibility. The MOT decided that it will check in advance only about fundamental matters that determine the level of safety, such as a fundamental matter about an adjustment needed for environmental considerations.

(See Separate sheet 5)

3) Progress of the Authorized Enterprise System Introduction and Our Company

The statute relative to this is already fixed.

Therefore, a railway enterprise which is going to receive authorization is in the state where an application is possible, and the MOT which received the application will perform document examination and actual examination, and if satisfactory, will recognize this.

Our company is now making application preparations and is going to apply in this year.

(2) Formation of performance regulation of a technical standard

For the technical standards under the ministerial ordinance the performance required in principle is specified so that technical judgment reflecting introduction and the individual situation of new technologies might be employed. In the form without legal force, an interpretation was made and evaluated and was specified as an" Interpretation standard " In addition, the setting basis and view point of the ministerial ordinance and the interpretation standard were collected again. That is the "Solution Opinion."

In addition, a railway enterprise decides upon the detailed internal regulation that unites the interpretation standard, Solution Opinion, etc. with each actual condition at reference within limits that suit the ministerial ordinance. That is the " Enforcement standard "

(See Separate sheet 6)

1) Matter Specified in Ministerial Ordinance Formed into Performance

Regulation

"Preservation of safety" "Preservation of planned transportation schedules" " Consideration of mobility-restricted persons" " Consideration of the environment" are subjects for which necessary minimum standards are defined, in agreement with the present ministerial ordinance. The MOT decided in principle it does not set standards such as structural standards.

2) System of Ministerial Ordinance

In general, similarly irrespective of the kind of railway, since railway construction, vehicles, and operation are indivisible, for the requirements for performance in the technical standards for a railway it was decided that the regulations about structures and operations should be unified. (See Separate sheet 1)

3) Progress in Formation of Performance Regulations for Technical Standards, and Our Company

From December 1998, the decision of the draft proposal of a ministerial ordinance formed into performance regulation, an interpretation standard, and a solution opinion was started by the members who are specialists with learning and by experience and the railway enterprise.

In the last fiscal year, at last, the draft proposal and interpretation standard of a ministerial ordinance that were formed into performance regulations were settled, and it has become the schedule proclaimed and enforced during this year.

In addition, a railway enterprise sets "Enforcement standards". These are like the present internal rules and it should be possible for the Enforcement Standards to replace those rules. When introducing a new device or a new operation, within limits which suit the ministerial ordinance as formed into the performance regulation, it will be subject to the railway enterprise's self-responsibility and notice will be submitted to the MOT.

For this reason, the outside intelligent persons were included in our company "Railway technical conference". We decided that advice from the Conference would have an objective view about enforcement standards, such as the specification and the system corresponding to the ministerial ordinance formed into performance regulation, and about numerical standards.

(3) Thoroughness of post-accident check techniques

Since the MOT eased prior regulation sharply, it has decided that a thorough audit of safety must be aimed at preservation of a railway enterprise's safety, and the same is true of actions taken following railway accidents. Moreover, former regulations that will be retained provide that, when there is unsuitable enterprise management and an accident is caused, the MOT will make a check in order to devise a correction measure.

1) Inspection

Periodically, from a railway enterprise, the MOT receives a report of the status of the enterprise and regularly keeps informed of the situation. Moreover, a safety audit by field inspection was carried out on a fixed cycle by MOT and by its local organizations. This is changed. A specific theme is chosen, and checking is scheduled and systematic. Within an enterprise, however, the situations generating any accidents and the operation situation, etc. of the accident are taken into consideration.

Moreover, since it responds not only to preservation of safety but, also to various requests from users about the object of an audit, the MOT examination which checks the situation will also examine matters in connection with preservation of convenience, consideration of the environment, etc.

In addition, since the MOT checks the situation of railway enterprises regularly, it has decided and planned to aim at curtailment of the data required from a railway enterprise in audit.

2) Response when Railway Accidents Happen

In order to aim at a safer railway, it is very important to take effective measures that are targeted on the location of the problem, taking advantage of what is learned from the accident, etc., and to prevent another accident of the same kind before it happens. Therefore, investigation and analysis of the accident aiming at cause investigation of the accident and prevention of the same kind of accident is performed. And it is necessary to accumulate the knowledge and to reflect it in safety measures.

Therefore, suppose that a railway enterprise performs a special investigation of causes of an accident or incident. In addition to this, suppose that the MOT performs investigation and analysis of the accident or incident from the position of fairness and neutrality. Then, a railway enterprise's investigation and analysis result is evaluated exactly. The organization was fixed in June of last year. (See Separate sheet 7)

The organization that investigates when there is a major the accident and a unique accident causing will be set up for the accident. This will be a MOT organization, and its members will be people of learning and experience and specialists. The title will be "Accident investigation examination meeting" and it will be the Ministry of Transport Railway Bureau chief's consultative body.

There is also an organization that works on measures effective in prevention of accidents before they happen. This is the "Accident analysis subcommittee". This consists of persons of learning and experience and specialists like the accident investigation examination meeting. This committee is the organization that is usually working on the measures against accidents.

In addition, this subcommittee analyses minor accidents, incidents, and events that may have an influence on safety. Therefore, since it becomes a major burden for a railway enterprise that reports an event, the way that this reporting should be done, method, etc. are being examined among enterprises now.

(4) Promotion of freedom of information

In December 1996, the MOT decided on "Information to be offered guidelines for railway enterprises". From this, implementation of information offers by railway enterprises and administrations have been achieved, focusing on information concerning freight charges. In addition, offers of many other kinds of information have been made, with each railway enterprise using its originality in ideas.

As a result of this deregulation, a railway enterprise's independence is expanded much more and the width of selection available to users of becomes large. Therefore, it is expected that freedom of information have a positive effect from the viewpoint of competition for free selections by the user, and for improvement in service and for efficiency increases within an enterprise. This is being examined in consideration of the role assignment for what a railway enterprise performs, and the role that the MOT performs.

1) Information Which Railway Enterprises Provide

- Fundamental information about transportation freight and Passenger charge, schedules, vacant seat information, etc.
- Railway accidents that are unique to an enterprise and information related to safety
- Information about the level of services, such as the rate of on-time schedule performance, passenger congestion, convenience of transfer between lines, station facilities and services.

2) Information Which the MOT Provide

- Information considered to be useful from the viewpoint of free selection and preservation of self-responsibility (information which compares and verifies the results from each enterprise)
- Information which serves as the basis for judgment about freight and passenger charge approval assessment

5. Conclusion

As mentioned above, in our country, examination of deregulation was just going to be advanced. However, on the Teito Rapid Transit Authority, an accident in which passengers died happened by a train derailment on March 8 this year. This accident was generated in a curve with a radius of 140m. It was a disaster, with five dead and 38 injured by the accident. If a derailment prevention guardrail had been installed on that curve, it has been suggested that possibly the derailment could have been prevented.

Now, the judgment of installation of a derailment prevention guardrail is left to the enterprise. However, people have said, about the installation standard of such equipment after this accident that "The country should come out and do the guideline." This is argument that went back against the flow of the original deregulation.

But the operation accidents on the railway of our country are decreasing and safety is improving, as mentioned above.

Railway enterprises study the causes of accidents by their own efforts, and this has been a prevent measure for prevention of repeated accidents. It is the result of always endeavoring, through technical development or equipment investment, to eliminate accidents.

Therefore, we believe that deregulating will not allow safety to fall. Moreover, as new technology is introduced, become it has great advantages, our company would like early achievement of deregulation.

International Rail Safety Conference

2000 LONDON

8 November - 10 November 2000
Forum Hotel, London, United Kingdom

Paper 0022

George Smallwood

Implementation of Fatigue Countermeasures within Collective Bargaining Framework

Publisher
2000 International Rail Safety Conference

International Rail Safety Conference

George Smallwood

Assistant Vice-President, Manpower, Training & Operating Practices

Burlington, Northern & Santa Fe Railway Company, US

IMPLEMENTATION OF FATIGUE COUNTERMEASURES WITHIN THE COLLECTIVE BARGAINING FRAMEWORK

Presented To

THE INTERNATIONAL RAILWAY SAFETY CONFERENCE

November 8 – 10, 2000

By

George A. Smallwood

Assistant Vice President, Manpower, Training & Operating Practices

Burlington Northern and Santa Fe Railway Company

IMPLEMENTATION OF FATIGUE COUNTERMEASURES WITHIN THE COLLECTIVE BARGAINING FRAMEWORK

Presented To

THE INTERNATIONAL RAILWAY SAFETY CONFERENCE

November 8 – 10, 2000

By

George A. Smallwood

Assistant Vice President, Manpower, Training & Operating Practices

Burlington Northern and Santa Fe Railway Company

Industrial fatigue is not a new concept. The effects have been well documented by scientific studies, and, all too tragically, the loss of human life Though long recognized as a safety concern in the rail industry, fatigue has seldom been addressed in collective bargaining agreements By mutual deferment, fatigue has been relegated to an afterthought, a second sister to the traditional pay and working conditions that have dominated the collective bargaining landscape for over a century. In many cases, existing agreements actually encourage fatigue conditions and restrict the possibility of implementing corrective measures.

But the landscape is changing. Moving forward into a new century, fatigue is at the forefront of organized labor's agenda Management too, recognizes the tremendous costs associated with fatigue related failure The question is no longer whether rest issues will be addressed, but how both parties can navigate through a maze of existing agreements to facilitate the process

To put human fatigue into perspective, it is useful to employ an analogy. Metallurgists have long known the relationship between metals placed under varying degrees of stress for extended period of time. We know, for example, the potential outcome of tired rail, wheels, wings and rudders. It is a recipe for disaster. We therefore take precautions against this kind of failure and wouldn't think of installing fatigued parts nor expect them to perform with the reliability of a new set. Yet we routinely expect tired trainmen and engineers to perform with the same reliability of a rested crew. We do not ask metal to stand to super-metal requirements, why then do we ask our crews to perform to super-human standards?

Fatigue can not be conquered, but it can be managed. Creation and installation of fatigue countermeasures is a must for our industry. It not only makes dollars, peso, yen and pound sense, it is the right thing to do.

We work in a mature industry, one driven by past practice. The history of our operations is embodied in the text of the many labor agreements that provide the framework in which we coexist; labor, management, customers, regulators and the general public. All these influences came together in the creation of these instruments and all the world is effected by their implementation. Because of the effect and effort involved in creation, these rules are tenacious and resist change. Overlay this steel fabric with the need to add fatigue countermeasures and you have the railroad version of the irresistible force meeting the immovable object.

The two primary parties in collective bargaining have decidedly different agendas. One side desires to maximize productivity while minimizing expense. The other wants to increase income and comfort while minimizing time expenditure. If we were to condense all the hoopla surrounding collective bargaining we would have one element wanting more pay and less work while the other desires more work and less pay. Perhaps oversimplified but nonetheless the embodiment of an "arms length transaction." All in all, not a bad situation from the standpoint of regulators, customers and the general public but a huge dilemma for the participants inside the ring.

A boxing match is a good analogy. The spectators (customers) want someone to go down. The referee (regulators) insures that one side does not have an illegal advantage over the other The contestants (negotiating parties) both want to knock the other down but have to be careful not to violate the rules (fines, etc.) or upset the fans (they will take their business elsewhere). So, if you have literally shed blood to get where you are, why change except to better your position? We have arrived at the *quid pro quo* stage. I will trade you for something only if I perceive that trade increases my value and position. The trick is to maneuver both sides into understanding that fatigue countermeasures represents "value added" to both of their respective components; the win-win strategy in the Numbers Game Theory.[i]

Science is exploding with new information on fatigue. Rationalizing a countermeasure system that incorporates with these new findings can be confusing. Adding the complexity of labor negotiations complicates the endeavor exponentially. Additionally, the line between countermeasures drawn from science becomes confused with "quality of life" issues that inevitably enter this picture. We have found that it helps to simplify information, formulate goals and develop the strategy to obtain that vision. What was not apparent within the framework of traditional collective bargaining process was the idea that including the opponent in the process (in our case labor) from the beginning actually facilitates the effort. Historically, you needed the secret handshake and password to get into the smoke filled back room to plot your attack on the other party. Horse trading abounded and your starting position was usually the equivalent of ransoming the moon; the proverbial game of "chicken."

Within the rail industry in the United States, the initial fatigue countermeasure efforts were handled in the traditional, confrontational manner. This resulted in a plethora of proposals and projects with little or no coordination and networking To assist in the effort, the Association of American Railroads (AAR) established a Work/Rest Task force inviting representatives from all major rail companies and operating craft labor organizations in the U.S. and Canada. The Work/Rest Task Force was very effective in the networking of information. This greatly aided the quest for validation and standardization of fatigue countermeasures. One major contribution of the Task Force is the ongoing publication of the "Fatigue Countermeasures In the Railroad Industry: Past and Current Developments," prepared by Patrick Sherry, Ph.D., University of Denver[ii]

The regulators, to broaden base and influence, created the North American Rail Alertness Partnership (NARAP) which basically encompassed the AAR Work/Rest Task Force and included the Federal Railroad Administration (FRA), National Transportation Safety Board (NTSB) and representatives from non-operating craft labor organizations. The AAR Work/Rest Task Force remains in place to direct efforts specifically aimed at operating crafts.

Despite the excellent informational sharing avenues available in these committees, installation of fatigue countermeasures in the U.S. remained a mostly speculative and experimental effort with very little general dissemination of countermeasures as routine. Only two areas had reached the general use category: fatigue countermeasure/lifestyles education and short restorative napping, a.k.a. power naps. The competitive aura of collective bargaining was still a chasm between theory and application of these measures. The breakthrough came in an unusual setting, the National Carriers Conference Committee (NCCC), a traditional collective bargaining group tasked with negotiating rail labor agreements at the national level. Several of its members from both sides of the table realized the snails pace in the countermeasure arena while at the same time understanding the importance of the issue. The result was the "National Work/Rest Guidelines" which, among other things, specified that fatigue countermeasures would be pursued with financial neutrality, a so-called "cost neutral" approach. The idea was not to discourage investment in R & D or that the long term effect of a fatigue countermeasure project would be without economic effect/impact but that neither side would insist on a *quid pro quo* to advance an issue. It then became possible for both sides to lay their cards on the table and seek common goals.

The most important rule in implementing fatigue countermeasures within the framework of existing labor agreements is including labor as a full partner from the beginning.

With all parties now on equal footing, common goals must be established. These goals will be intrinsic to applicable operations and problems encountered therein. In our organization, as we wrestled with goals, two simplistic questions continually surfaced: 1) When am I going to work? and 2) When am I going to be off work? Aside from the flowery corporate language of mission statements and evidences of success, these two questions formed the basis of the goals that management and labor agreed to work towards solving: providing our employees with the information, schedules and opportunity to secure adequate rest. Please note that this goal does not commission the company as "sleep police." This "fitness-for-duty" mindset is one of the issues that labor and management could not agree upon in determining goals. Consequently, it was not pursued as a fatigue countermeasure issue within our company. Regulators and other interested parties may well enjoin activity in this area separate from our internal efforts.

Establish common goals.

With specific direction now defined in goals, we began the long trek toward solutions. It is important to note that while seemingly simplistic, the two questions mentioned above proved to encompass an unimaginable set of options It does not take much experience in this subject to realize the importance of segmenting the goals into "bite-sized" chucks. We quickly discovered the formidable task of being "all things to all people." Our first attempts at fatigue mitigation involved trials designed to satisfy both queries Examples are on-duty windows, assigned train-to-crew, meet and turn, and tracked windows. While achieving substantial success in these pursuits, the overall programs were very cumbersome and difficult to manage resulting in an unacceptable level of dissatisfaction between management, labor or both. Sophisticated scheduling tools were dependent upon an infinite number of rail operating and human resource variables common to all rail endeavors. Temporal estimates (lineups, equipment and human) are another subset of negative variables. Each level of complexity represented a catastrophic multiple in terms of what could go wrong. In this business, Murphy's Law prevails. In fact, Murphy was a railroader.

Breaking the process into the two separate questions referred to earlier, yielded a wealth of information. Some locations felt that only one question need be satisfied to accomplish our goal. "When am I going to be **off** work" was paramount in the minds of many employees. Many seemed unconcerned about the work regimen opting instead for a higher value on time off. An interesting note, while debating the relative importance of these two questions at lunch with colleagues, I was rudely interrupted by a lady at a nearby table. Her comment to me as her husband sheepishly looked on, "When he's at work I don't care what you do with him, but when he's off – leave him alone." This restaurant was across the street from one of our outlying rail yards and the conductor was meeting his wife for lunch. Here endeth the epistle.

In past practice, employees had to request that his/her name be removed from the working list, temporarily, in order to observe time away from the job; the so-called "lay off." It is a quirk of nature that request for absence always come when the board is exhausted of personnel necessitating a negative answer. Weekends and holidays are premium. Concentrating on the "when am I going to be off" side of the equation lead us to our very successful assigned rest day program. In short, this process gives assigned rest days to service that previous had none. In addition, these boards are configured mathematically to allow even access to weekend absence. By preventing the sum of rest days and work days from equaling seven or being evenly divisible by seven, rest days will change each cycle. Compensation issues differ from agreement to agreement causing substantial diversity in the implementing agreements for these assigned rest day programs, which leads us into our next rule.

One size does not fit all.

One mechanism to reduce the complexities mentioned above for relatively large operations is to understand that one countermeasure may not be appropriate for all locations or even different groups within the same location. While standardization is the dream of every rail supervisor, it simply will not work in this environment. Implementers must be free to limit the negative influence of the major variables applicable to the operation at a particular location. One driver of this requirement is the many and varied labor agreements and payroll requirements that most railroads have throughout their operations. Others are traffic levels and flows, schedule consistency, deviation penalties, trip turn-around time, total time on duty over long periods and average trip time-on-duty.

In some cases the compensation structure is left alone with the assigned rest days superimposed over the pool matrix (overlay). This works particularly well in non-guarantee and non-salary arrangements. The "quality of life issue' raises its head at this juncture with labor insisting that its "right-to-earnings" is abridged by restricting the maximum possible work schedule Science will support the reduced work schedule; finance will not. Without directional authority (legislation, law, etc) mandating otherwise, a compromise must ensue. In our case, one solution is to allow employees to voluntarily work on their assigned rest days provided they are fit for duty (in their personal estimate) and the covering source of manpower supply is exhausted.

Overlaying a guarantee board with assigned days off is another option that is proving useful A window is created via an overlay matrix and the employee is entitled to "lay off" during that window at his/her discretion, not at the whim of crew management. Pay considerations are not changed Basically, this is a "stop the world and let me off" mechanism at the employee's control. Previous lay off procedures are still available. Several conveniences can be leveraged to attract the employee to utilize the window rather than random layoffs. Examples are consideration against attendance requirements, predictability and, as previously mentioned, not having to tangle with the crew office.

Allowing rest periods between trips to exceed existing legal standards is another "when am I going be off" countermeasure. Crew must have eight hours off between trips of less than 12 hours Trips of 12 hours qualify for 10 hours rest. This rest period is inclusive of any call time meaning the employee can have his rest period invaded by the allowable call time, usually 90 minutes. The current practice, where requested by labor, is to encircle the required rest time and remove call time, insuring a minimum "undisturbed" rest.

In a few cases we have negotiated new pay standards. The intent is that neither party is negatively effected by the change. In practice, it is difficult to convince one side or the other that some impairment is not occurring. Additionally, if the new pay arrangement does not mimic national payroll agreements, over time the two different arrangements will track differently due to computation, inflation, technology and unforeseeable market trends creating either a premium or discount for one side, usually a no-no in the world of organized labor.

"Knowing when I'm going to work" is the other side of this coin.

This query can be further defined in two categories: 1) train lineup accuracy and employee lineup accuracy. Train lineup accuracy involves improving arrival/departure estimates, assigning employees to particular trains or time slots to allow the employee to know when he/she is going to work. Less than accurate information results in dissemination of poor estimates of train arrival and employee-to-train matching. Time works to exponentially exaggerate this error. The employee lineup is similar in nature. Variables effecting employee lineup are absences of all types, expected and unexpected, Hours of Service requirements and other authoritative instruments.

While the overall number of variables effecting the question of when employees will work appear to be less, they are certainly no less daunting. In long distance freight service, scheduling initiatives have had some impact on predictability but have not achieved the level necessary to mitigate conditions required to plan rest. Changing the focus of lineup accuracy to the crewmember as opposed to the train has increased lineup utility, but again, not sufficiently to plan rest. Efforts here will add value to the process with little or no employee concern. Efforts on the human lineup side, such as availability and absence reduction programs are intensely unpopular with employees possibly explaining some of the employee fascination with being off as opposed to scheduling initiatives.

Adding assigned rest days to the programs designed to provide work scheduling give rise to solutions of both questions. While this appears to be the pot of gold at the end of the rainbow, experience shows these operations to be very complex from both labor and management's standpoint. There are several consulting agencies that are developing software and process for introduction of calling windows, tracks and train assignments that considered traffic flow, density and regularity. Once evolved to an acceptable performance level the obstacles of wage and arbitrary payment must be considered. Implementation of these systems involves huge collective bargaining challenges that have thus far prevented implementation beyond the trial phase in the U.S. Canada has had some limited success with scheduling devices but has had several setbacks related to labor issues.

Develop strategy for accomplishing goals.

Strategy is the roadmap that ultimately leads to your objectives. Our strategy is to study each crew terminal and access the variables that enable or prevent installation of fatigue countermeasures. Once determined, evaluated and mitigated, where possible, these variables will channel selection of options available or give rise to new initiatives. These variables also determine which of the two questions (or both) that need to be answered to accomplish our goal at a particular location. Making the strategy joint with labor solves many problems up front.

Our experience is, in most cases, that the desire for predictable, dependable time away from work is the paramount issue for the employee's view. Relief in this area provides an immediate avenue of safety for train operating crews. Once established, the benefits of improved lineup accuracy and reduced employee lineup issues compound this improvement. Aggressive absenteeism policies tend to diminish results but may be necessary depending upon local circumstances. Allowing fatigue countermeasures to effect overall absenteeism before implementation of a more stringent attendance policy is preferable. As example, installing assigned rest days into boards that previously rotated in continuum will reduce absenteeism dramatically, in most cases. Let a new standard of availability arise from the new institution before impressing employees into attendance requirements; they may no longer be necessary.

When deciding to install processes that provides both assigned rest days and scheduling tools, a stepped process is advised, initially. Firmly establish one (usually assigned rest days) and then the other. Once a program has established itself as creditable from the employee perspective, it becomes significantly less troublesome to implement at other locations.

SUMMARY

Fatigue mitigation is necessary for a safe operation. Rail service employees are, in a sense, similar to any other asset. They need certain physical requirements to perform at optimum. Unlike other assets, people need social consideration. Predictability in our industry facilitates the physical and emotional needs of our employees while serving the business purpose of our various organizations. Fatigue countermeasures serve both the business and personal needs of our employees and us. It is the very foundation upon which rail safety must be built. A quick look at our individual histories show that as we begin to fulfil these needs, safety improves.

Many are asking, "What will take us to the next level of safety in the rail transportation industry?" I believe we have found the answer.

---

[i]See *Theory of Games and Economic Behavior*, John von Neumann and Oskar Morgenstern, (3rd ed. 1953); D. Fudenberg and J. Tirole, *Game Theory* (1994); M.D Davis, *Game Theory, A Non-technical Introduction* (1997), R.B Myerson, *Game Theory: Analysis of Conflict* (1997); J.F Nash, Jr , *Essays on Game Theory* (1997); A Rapoport, *Two-Person Game Theory* (1999)

[ii] *Fatigue Countermeasures In the Railroad Industry. Past and Current Developments*, Patrick Sherry, Ph.d, University of Denver, June 2000, paper at http://www.du edu/transportation/fatigue. Dr. Sherry at psherry@du edu

2000 LONDON

8 November - 10 November 2000
Forum Hotel, London, United Kingdom

Paper 0023

Colin Sellors

Second Plenary Session

Safety in the Supply Chain: Who is Responsible?

Note: This paper formed the keynote discussion paper for the Second Plenary Session. As the session was conducted as an interactive verbal discussion, no written paper is available of the outcome of these discussions.

Publisher

2000 International Rail Safety Conference

International Rail Safety Conference

Colin Sellars

Department Manager

AEA Technology

Plenary Session:

Safety in the Supply Chain: Who is Responsible?

INTERNATIONAL RAIL SAFETY CONFERENCE

9th November 2000

Safety in the Supply Chain – Who is responsible?

Colin Sellers,
Manager, Safety & Risk Management Department
AEA Technology Rail

Introduction

The spotlight has fallen, once again, on the safety of the railway. Whilst there is an ongoing investigation into the causes, it seems possible that somewhere in the supply chain of services, in this case for track inspection and replacement, there has been a failure to deliver the safety performance needed.

This paper attempts to identify the key elements (vital links) in the supply chain and highlights some of the safety responsibilities of these vital links. The organisations, especially people, who make up these links are identified as they are key in making the chain strong.

The paper identifies, at a high level, how the supply chain delivers the safety performance and whether this performance matches (or exceeds) the safety performance requirements.

The key areas of safety responsibility are identified, with some indication of how these responsibilities are, or indeed could be, addressed by the appropriate organisations.

Finally, two things are presented First, a view is given on who is, or perhaps should be, responsible for safety in the supply chain. Second, some questions are posed, to stimulate debate both today and in the future.

What is the Supply Chain?

There is a tendency, before answering one specific question, to ask at least one other. That tendency is followed here, as before asking who is responsible for safety in the supply chain, it is useful to identify what the supply chain comprises.

It is almost universally accepted that the provision of a railway service is a "good thing". It is understandable that in providing this railway service, this "good thing", there is an expectation on the part of the people using it that it is safe. There is also the anticipation, on the part of the people providing the good thing, that it will be safe. However, these two views on "safe" may not, and often are not, the same. No attempt here is made to define what safe means in these different contexts other than to state there is an accepted view that "safety is.. ...freedom from harm". That is on the part of the user, there is the view that in taking advantage of this good thing, no harm will come to them.

9 November 2000
Colin Sellers
AEA Technology Rail
colin.sellers@aeat.co.uk

However the railway system is large and complex and, simply by considering the size and nature of the component bits (trains, wagons, track, bridges, stations, people, for example), the fact that there is the *potential* for users to be harmed is clearly apparent. It is in the supply chain that the potential to cause harm (and this is not meant to be pejorative, and harm may be caused unwittingly, accidentally or deliberately[1]) is addressed and tackled. By using the theme of the potential to harm, the concept of uncertainty, and from then, risk is raised. Again, there is no attempt here to talk about risk, or ALARP, or other concepts, although the use of safety and "acceptable risk" as synonyms should be highlighted

Now, having decided that the railway is a good thing, what needs to be in place to deliver it?

The railway service is provided by a railway operation that is reliant upon maintenance, the development and delivery of products and services, both tangible and intangible and the provision of the wherewithal (those trains, wagons, coaches, track, etc) to make the overall performance of the service match the expectations. In the UK, this is delivered in an environment defined by legislation and standards.

Who is in the Supply Chain ?

There are a number of bodies involved in the Supply Chain From standards organisations and "regulators" through service and equipment providers (Railtrack, LUL, ROSCOs), manufacturers, maintainers and operators (TOCs, FOCs), the supply chain lengthens, until users start to get the service they desire. Does this supply chain deliver the good idea or are there other bodies to satisfy?

Safety in the Supply Chain

Underpinning safety requirements as a minimum[2] are those legal Acts and Statutory Instruments and other "Standards" bodies, who attempt to identify safety requirements, including how they might be addressed. The Regulator and, in the UK, the Railway Group provide high level responses to these, to be addressed by the other links in the Supply Chain. The service providers respond to these, either as a legal obligation (e.g. Railway Safety Cases, RSC) or as part of their duty of care. The infrastructure providers, in particular, must address the safety across the network they provide, with all the complexities and interfaces that this brings.

Manufacturers, as providers of products, have a legal duty to ensure their products are safe and fit for their intended purpose and for use on the infrastructure, but in a complex operating environment they need to understand the risks posed by the different interfaces. They are required to have their products scrutinised and for them

[1] This paper assumes that those in the supply chain understand their duty of care That is, their interest lies in ensuring the strongest supply chain, not in acts of vandalism, or other wilful acts aimed at causing harm

[2] My interpretation, as there should be a desire to exceed standards, not merely match them

9 November 2000
Colin Sellers
AEA Technology Rail
colin.sellers@aeat co.uk

to have a "Product" Safety Case. Similarly, support service providers (builders, installers, maintainers, etc) are required to respond to the infrastructure RSC with their own Contractor's Safety Case, which may well detail their responsibilities under other legislation, the Construction (Design and Management) Regulations (CDM for short). Operators have a safety case of their own, be they freight or passenger or other types of operator.

The public, society at large, has a role in the delivery of safety, particularly in identifying requirements and understanding the reasons for any shortfall in safety performance.

Safety Performance Requirements

Society has a view on what level of safety it wants form the railway, and individuals have their own views as well. These views are articulated, perhaps through legislation for users *as a whole*, but these may be different from any individual perspectives. These are developed as high level specifications, which in turn become industry standards. Designers and developers interpret industry standards, perhaps in combination with standards from outside the rail industry, to produce design and manufacturing standards, all aimed at addressing the safety requirements.

Installation and maintenance standards define much of what happens to support and ensure safe operations and the standards for operational issues continue this. This results in the safety performance achieved. This is compared with the "user" or societal requirements (which may have changed) and the cycle begins again.

Safety Responsibility

It can reasonably be expected that the management of safety throughout the railway will be investigated and tested to determine whether, across the railway as a whole, such management is effective in ensuring the safety performance required is met. Such interrogation of the management and management systems should be ongoing as this is a key element of achieving success in the management of safety, and of course health. In part, this is addressed by audits against Railway Safety Cases, but not all elements within the management of the supply chain in the Railway Industry (in the UK) are covered by the same audit protocol.

A pyramid of responsibility, with society at the apex, can be identified. Manufacturers produce things to requirements, as identified earlier, and these are delivered to operators. Operators must understand how these products interface with their own systems and whether any new safety management issues arise. In turn the operators have different needs which must be addressed by the service providers, and in doing so, the "regulatory" framework may need to be addressed. Note that in situations where society's representatives prescribe a new "good thing", all tiers may need to readdress how they approach the management of safety to carry out effectively their safety responsibilities.

9 November 2000
Colin Sellers
AEA Technology Rail
colin.sellers@aeat co.uk

Importantly, users (society) must ask for a performance that is achievable, affordable and acceptable if the railway is to remain a good thing. Once this has been agreed it must be delivered. The links in the supply chain must feel that the whole is achievable, otherwise the chain will become weak, breaking at the weakest link and safety will be compromised.

Safety in the Supply Chain

Clearly, all involved have a responsibility, but at present no one body is taking overall charge. Regulation may not be the answer, as regulation is a way to discharge some of the aspects of responsibility, but not, perhaps, all of them. The Railway Industry should take charge and a single Railway Industry body, perhaps an expanded Railway Group should have overall responsibility for safety in the supply chain. Regulators can then discharge their obligations by matching safety performance against safety requirements, taking executive action as appropriate. It should not be left to Government, as the Railway service can be expected to outlive governments, and, in any case, politicisation of safety is undesirable.

Conclusions

Safety in the supply chain is a curate's egg The industry is doing well in some areas, less so in others. This needs addressing. Operational performance and safety performance are not mutually exclusive, but there should be clear communication of what is being traded off with what. Good processes exist, including those in HaSaWA, and these should be adopted, or where they have been adopted, improved. The industry needs to understand society's requirements and identify how it is going to deliver these requirements. If they can't be delivered, it needs to identify what is being done instead.

International Rail Safety Conference

2000 LONDON

8 November - 10 November 2000
Forum Hotel, London, United Kingdom

Paper 0024

Brian Clementson

The Supply Chain: Design/Components/Rolling Stock and Beyond

Publisher
2000 International Rail Safety Conference

International Rail Safety Conference

Brian Clementson

Director, Safety & Quality

Virgin Trains, UK

The Supply Chain - Design/Components/Rolling Stock & Beyond

International Railway Safety Conference 2000

The Supply Chain:

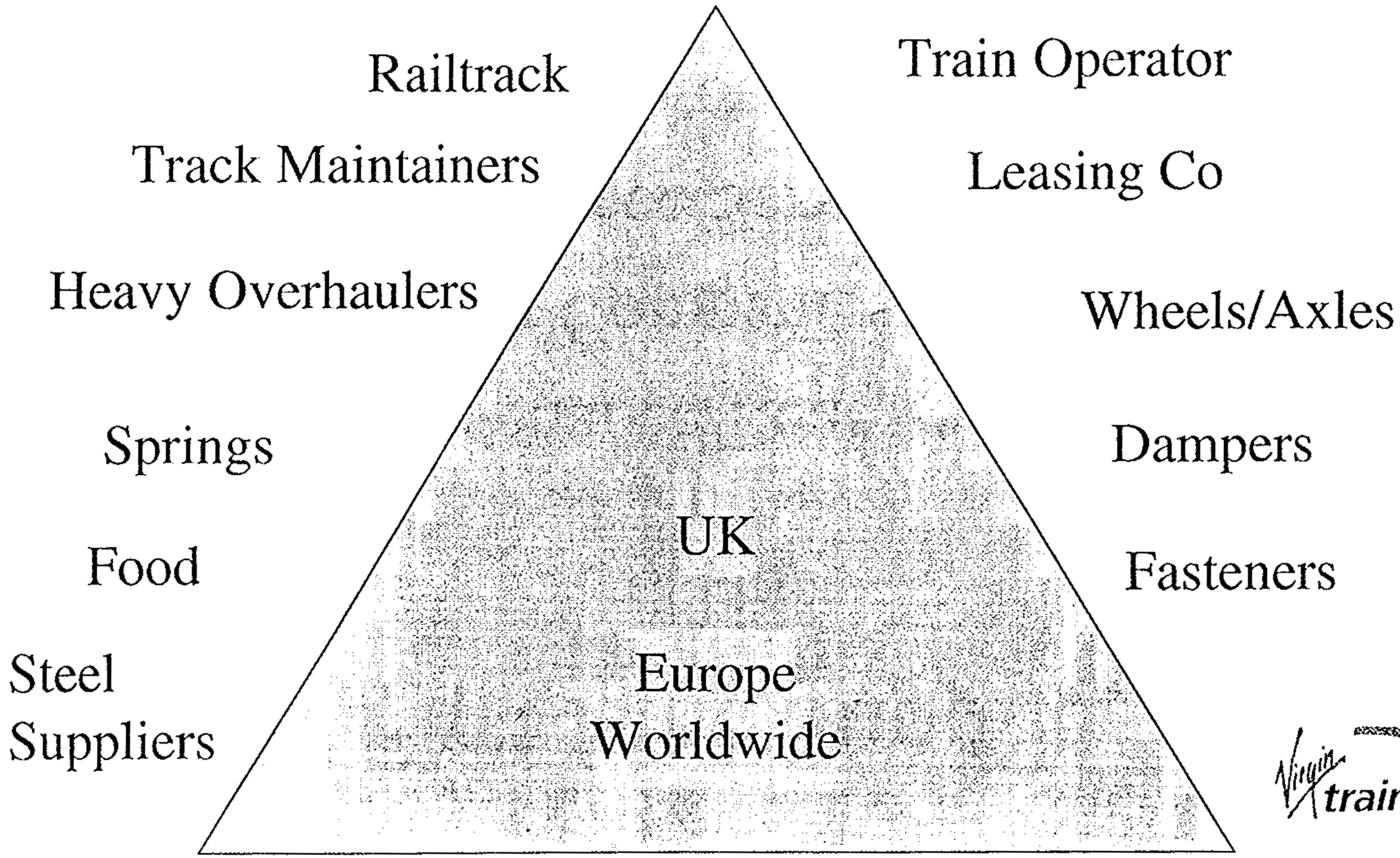
Rolling Stock, Components and Before

9 November 2000

A Train Operators Perspective

- Accountable for a safe operation
- Railway Safety Case
- Health & Safety at Work
- Other legislation
- Rail Regulators
- Customers
- Staff/neighbours/suppliers/contractors

Supply Chain Penetration

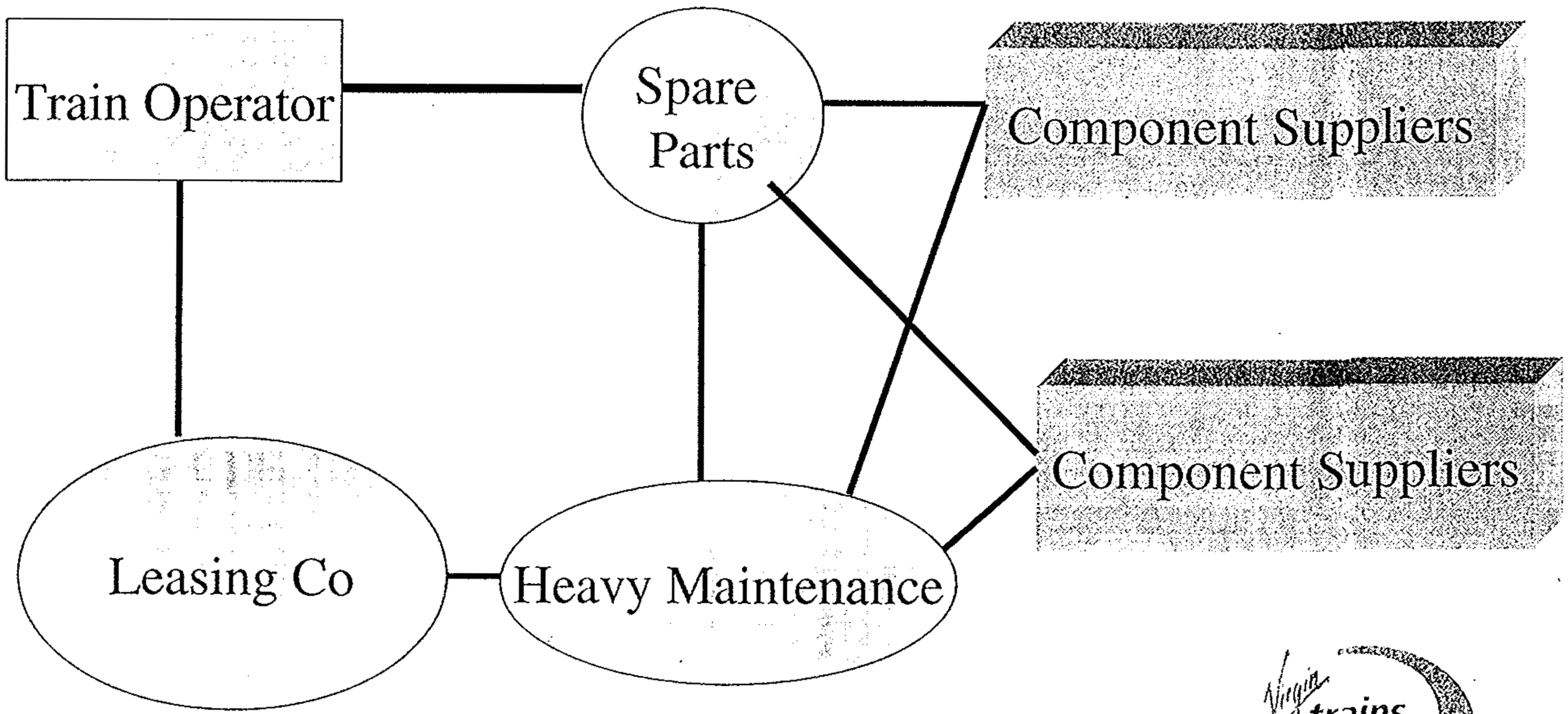


Virgin trains

First Line Suppliers

- Railtrack
- Track Maintenance/Renewal
- Train Leasing Companies
- Train Maintenance/Service Providers
- Other Train Operators
  - Stations/Depots
- Food/Catering supplies
- Consultants

Trains

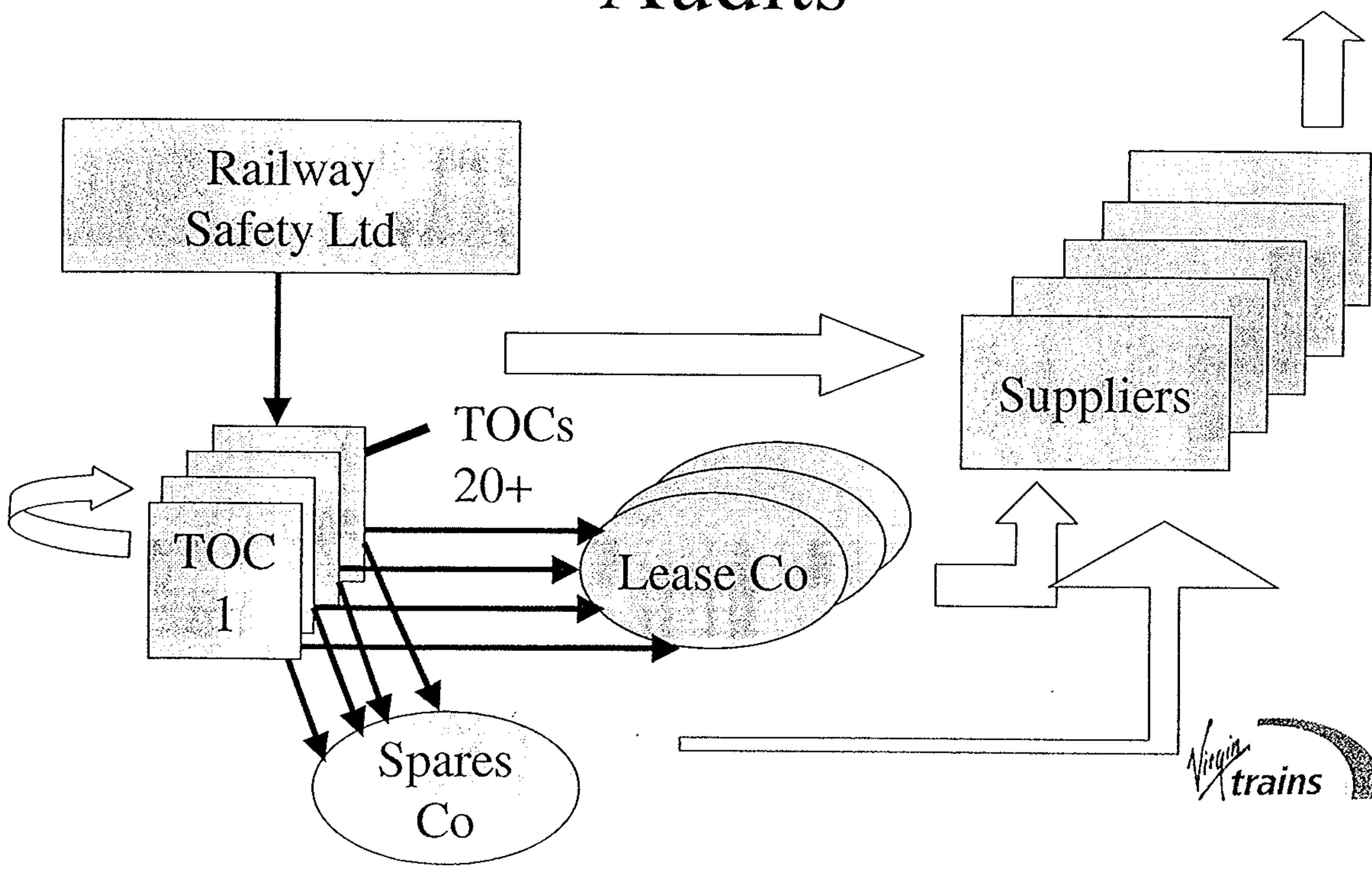

Train Operator
Spare
Parts
Component Suppliers
Component Suppliers
Leasing Co
Heavy Maintenance

Industry Initiatives

- Railtrack
- Railway Industry Association
- ATOC
  - Audit Programme
  - Key Safety Components
  - Audit Overload

Virgin trains

Audits


Railway Safety Ltd
TOCs 20+
TOC 1
Lease Co
Spares Co
Suppliers

What Next?

- Supply Chain Alignment
- Audit Programme Effectiveness
- Collaboration
- Safety and Performance Benefits
- Identify Critical Areas
- Continuous Improvement

Virgin trains

Soft Issues

- Schedules
- Specifications
- Drawings
- Traceability
- Change Processes
- Standards
- Verification

International Railway Safety Conference 2000

The Supply Chain: Rolling Stock, Components and Before

9 November 2000

International Rail Safety Conference

2000 LONDON

8 November - 10 November 2000
Forum Hotel, London, United Kingdom

Paper 0025

Dr Jacob Kam

The Assurance of System Safety for the Hong Kong MTR Network: Modifications and New Extensions

Publisher
2000 International Rail Safety Conference

International Rail Safety Conference

Jacob Kam

Safety & Quality Manager

MTR Corporation, Hong Kong

<u>The Assurance of System Safety for the Hong Kong MTR Network: Modfications & New Extensions</u>

The Assurance of System Safety for Hong Kong MTR Network Modifications and New Extensions

Jacob C.P. Kam, Ivan C.K. Lai
Safety & Quality Department
MTR Corporation, Hong Kong

ABSTRACT

When the Mass Transit Railway in Hong Kong was inaugurated in 1979, it featured only one urban line. In less than two decades, the system has been expanded to comprise 4 mass transit railway lines and a dedicated Airport Express Line (AEL).

In fact, the network is being continuously upgraded. Major upgrade work in the existing network includes for example, station improvement and retro-fitting platform screen doors. A new extension, the Tseung Kwan O extension, will also become operational in 2002

MTR Corporation Ltd. (MTRCL) has developed an Integrated System Assurance framework in order to assure the operational safety of these diverse and major works. This framework covers the full asset life cycle from conception, operations to final replacement / decommission. The elements of the framework include value assessment, hazard management, operability and human reliability analysis, software assurance and maintenance optimisation.

This paper describes the essential elements of the MTRCL Integrated System Assurance framework. Emphasis, however, will be put on the lessons learnt from the application of the methodologies in the new extension projects and the network improvement projects.

1. Introduction

MTR Corporation Ltd. (MTRCL) built and now operates an underground railway system in Hong Kong, meeting a major portion of Hong Kong's transport needs. The system was first opened to the public in 1979. It now consists of 44 stations, distributed along four MTR lines and a dedicated Airport Express Line (AEL) stretches over a total route length of 82.2km (Figure 1). The current daily (weekday) patronage is over 2.2 million.

The Corporation is also continuously upgrading the system and major works such as EMU re-furbishment, station improvement, and retrofitting platform screen doors are at different stages of development and implementation.

This paper describes an integrated system assurance (ISA) framework for assuring fit-for-purpose performance of new railway assets in terms of reliability, availability, maintainability and system safety (RAMS) throughout their asset lives. This paper describes the principles of the methodology, how RAMS related engineering activities are integrated into a common framework, and how it can be applied to suit the needs of different operational practices and equipment.

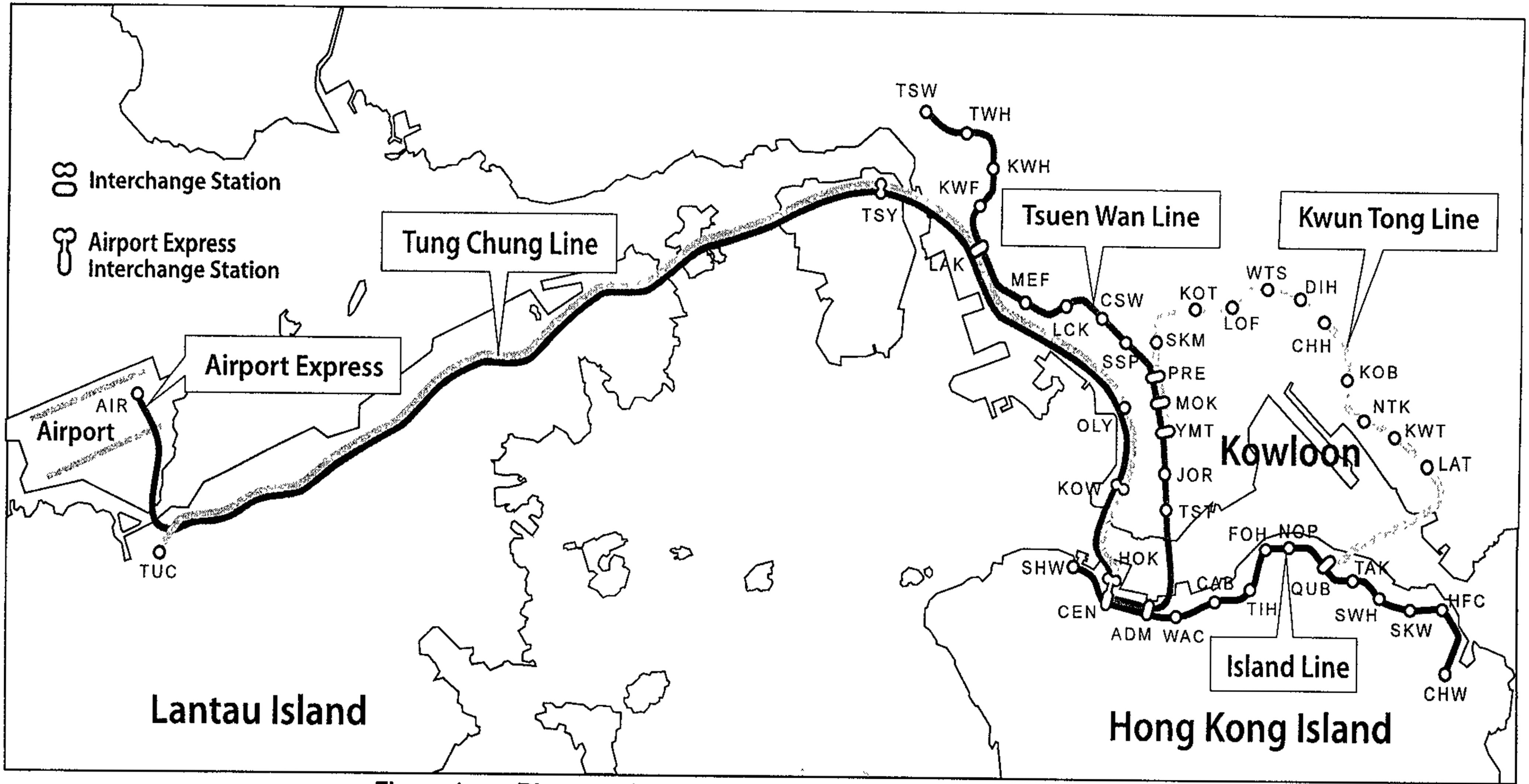


Figure 1 Diagram showing the MTRCL Operating Railway Network

2. OVERVIEW OF THE ISA FRAMEWORK

2.1 The Foundation of System Assurance

The principal function of system assurance in MTRCL involves undertaking specific tasks in various phases of asset acquisition or modification programmes in order to help ensure that the delivered equipment is "fit for purpose" i.e. it performs consistently to the required safety, reliability and efficiency standards.

The ISA framework is built upon the Safety Management System of the Corporation. The Safety Management System [Gaffney 1999, Kam 2000] provides a structured approach with the appropriate organisation (competent people with defined responsibilities) and arrangements (adequate control processes, procedures and standards) to ensure suitable and sufficient implementation of the ISA framework.

System assurance can be considered a special form of safety management for managing modifications or new extensions to the railway. Instead of identifying a series of operational safety tasks to be managed on a day-to-day basis, a series of project-specific system assurance tasks will be performed. These tasks, once performed satisfactorily, will assure that the modifications or the new extension meet the safety and reliability objectives of the project [Kam & Lai 1999, Lai & Ng 1999].

2.2 The Structure of the ISA Framework

The framework is organised according to the project life cycle. For project risks arising during asset design, construction and operation, the system assurance tasks to be applied will vary. Figure 2 shows how the various types of system assurance tasks come together in a closed loop manner to help achieve the "fit for purpose" objective. The tasks are further discussed in Section 3 of this paper.

2.3 Integration of System Assurance into Project Management

The basic philosophy of safety management in the MTR Corporation, as in many other major companies, is that the safety responsibilities are with the "line management" (these are personnel who have direct control over the work) [Ball, 1996, Cox and Tait, 1998, Lee 1996, Tong, 1995]. In the project phase, these include the Project Managers, Design Managers and Construction Managers who manage the design and construction processes of the new extensions.

The specific safety and reliability requirements and system assurance tasks that need to be carried out by the design consultant / contractor have therefore been placed in the relevant contract documents. By managing the fulfillment of the contracts, the managers will be able to ensure that due considerations have been given to the system safety and reliability aspects of their work [Kam et al 1999].

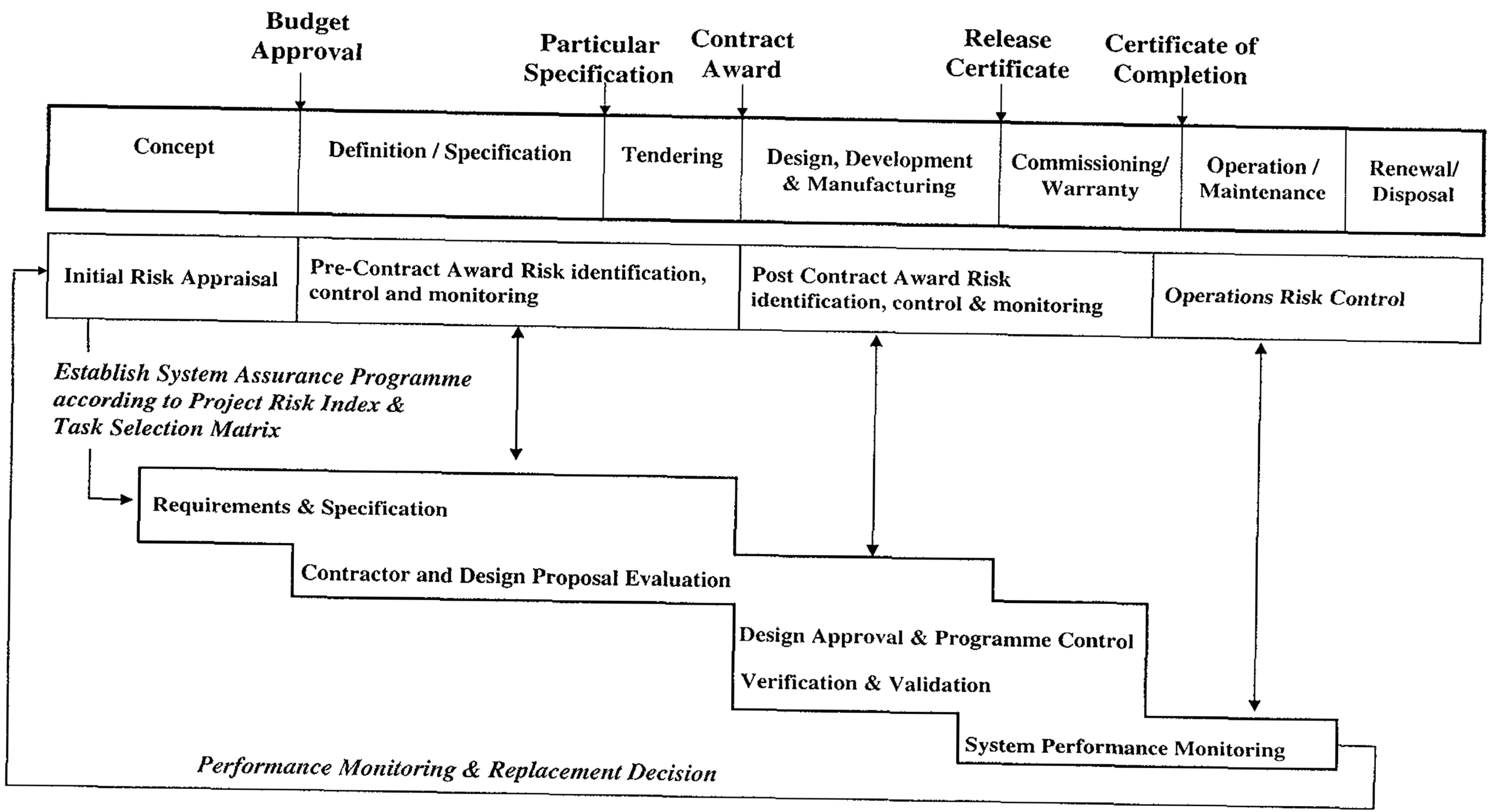


Figure 2 The Integrated System Assurance (ISA) Framewrok

3. THE INTEGRATED SYSTEM ASSURANCE PROCESS

3.1 Initial Risk Appraisal & System Assurance Programme Planning

During the concept & definition phase, an initial risk appraisal is conducted as part of the budget submission process in order to help management make the right business decision based on a better understanding of the potential risks involved. The risk appraisal results are reviewed and updated periodically to reflect changing circumstances [McCusker 2000].

The following eight risk areas are used for assessing project risk, during both system implementation and future system operations:

a. Health, Safety & Environment – potential risk to the health & safety of passengers, the public, employees and contractor staff, and to the environment.
b. Railway Service – effects to railway services.
c. Business Impact – this is related to the strength of the business case (and the return on the investment).
d. Cost Control
e. Programme (project schedule) control
f. Public Interest – this is related to the need to meet potential public interests or pressure over the work.
g. Technical Difficulty - difficulty in the design, manufacturing, implementation, operation, maintenance or eventual disposal of the system.
h. Complexity of requirements - Risk in achieving requirements for the work due to the nature and complexity of the project or the rapid development in technology.

The risk level in each of these 8 areas is then appraised on the basis of the best information available at the time on a scale 1-4. Risk Level 1 represents high risk and Risk Level 4 represents low risk. Having determined the Risk Level in each of the 8 Risk Areas, a suitable overall Project Risk Index (PRI) is determined, which ranges from 1 to 4 depending on the result of the risk appraisal. A PRI of 1 indicates a high risk of project failure whilst a PRI of 4 indicates a low risk. The PRI helps to tailor a system assurance programme that meets the technical and business needs of a specific project. The system assurance programme covers the RAMS activities to be conducted during the major phases of a typical project life cycle.

Table 1 illustrates how the Project Risk Index relates to the required level of system assurance effort, and is used for identifying the requisite system assurance tasks according to the assigned PRI. The tasks are classified as follows:

Mandatory : These tasks are normally required. In cases where the nature or scope of a project is such that certain mandatory tasks are considered not applicable, such tasks can be waived subject to a formal approval process.

Recommended : These tasks are normally cost effective. The project team considers on a case by case basis which tasks should be undertaken.

Optional : These tasks are usually not required for low risk projects. This is either because such tasks are usually not cost effective for low risk projects or because the existing control are considered adequate. The project team may wish to undertake them to suit specific project needs.

Table 1 System Assurance Programme Tasks Selection Table

System Assurance Task Selection Table					
Task No.	**System Assurance Task**	**PRI =1**	**PRI =2**	**PRI =3**	**PRI =4**
Requirements & Specification Management					
1	Value Assurance	●	●	●	●
2	Requirements Analysis	●	●	○	○
3	RAMS Specification	●	●	○	
4	System Synthesis & Optimisation Analysis	●	○		
5	System Interface/Integration Management	●	○	○	○
6	IOR Consultation and Inspection	●	○	○	
7	Software Assurance	○	○	○	○
8	E-M Compatibility	○	○	○	○
Contractor & Design Proposal Evaluation					
9	Contractor & Design Proposal Evaluation	●	●	○	
Design Approval & Programme Control					
10	Project Risk Register	●	○		
11	Project Interface Management	●	○	○	
12	Continuous Compliance Monitoring	●	○	○	
13	RAMS Design Assessment	●	●	○	
14	Maintenance Support and Logistic Analysis	●	●	○	
15	Maintenance Requirement Analysis	●	●	○	○
16	System Safety Management [Note 1]	●	●	○ Note 1	○ Note 1
17	Human Reliability Review & Assessment	●	○		
18	Operational & Recovery Management [Note 2]	●	○	○	
19	Design Review & Audit	●	○		
20	Data & Documentation Management	●	○	○	
Verification & Testing					
21	Verification & Test Programme	●	●	●	○
System Performance Monitoring					
22	DRACAS	●	●	●	○

Note 1 Project Hazard Log is a mandatory requirement for PRI 1 / 2 project. Some safety critical item related projects may be assessed as PRI 3 / 4. In which case Project Hazard Log, which is a sub-task under System Safety Management, is a mandatory requirement.

Note 2: Recovery process / Emergency response analysis is recommended for PRI 1 /2 project which includes any new significant infrastructure or rolling stock works and should include the review / revision of the existing contingency plan.

This "tailored" approach, i.e. matching effort to the need, is similar to the reliability programming methodology advocated by MIL-STD-785B and DEF STAN 00-40 Part 1, but these standards are too generic and broad, and do not always fully reflect the Corporation's needs. The Corporation's system assurance framework provides procedures and technical application guidelines that are compatible with the existing practices of OED.

When the applicable system assurance tasks have been selected, a programme plan is developed which ties together all the tasks. The programme plan stipulates all task owners and deliverables, and the task commencement and completion dates are linked to major project milestones.

One of the problems frequently encountered by safety or reliability engineers is the inability to influence design at the early design and development stages, and often this results in wasted effort, and/or additional cost to remedy. In order to ensure that RAMS issues are considered in a timely manner, the emphasis of the programme plan is very much on how the system assurance activities relate to and integrate with other design, development, testing, production, installation and commissioning activities.

3.1.1 New Railway Extension Projects

The above PRI rating is applied to major modification works in the existing railway. For the new extension projects, it has been found more effective when the whole extension is considered together with an overall system assurance programme to cover all the contracts for the extension. Based on the same principle as above, the system assurance activities for each contract will vary according to the level of risk and the importance of each contract to railway operation [Kam et al 1999].

3.2 Requirements & Specifications Management

For a complex system, it is necessary to address the following types of requirements and determine how best to meet them at the project specification phase:

a. customer / user requirements
b. functional requirements
c. system configuration and design characteristics
d. man-machine interface and system interfacing requirements
e. quantitative and qualitative RAMS requirements
f. specific system assurance activities to be undertaken by contractor during design, development, manufacturing and installation
g. verification and test requirements

Such requirements can be numerous, and experience has taught us that the following requirement-related problems can often cause programme delays and performance deficiencies:

- Incorrect interpretation of customer needs
- RAMS performance targets not based on actual customer needs
- Unrealistic RAMS performance targets
- Conflicting requirements
- Origin, changes and compliance status of requirements not traceable
- Contractor's interpretations of requirements different from those of the Corporation
- Ambiguous requirements
- Requirements poorly organised
- Requirements out of line with available proven products
- Overly complex systems

In order to minimize abortive work and contractual disputes, the Corporation has developed a systematic process, which involves the application of methods such as value engineering, value assurance of life-cycle cost, surveys, consultations, System Diagrams, Functional Schematics, Operational Flow Schematics, interface / integration management, software assurance etc. for requirements identification, evaluation, synthesis, tracking and documentation. These methods are particularly useful for defining system interfaces and requirements thereof. Together with a comprehensive set of technical / operational standards, project-specific fire design strategies and relevant safety principles [HSE 1996], the methods are able to support designers, operators, contractors and maintainers to understand and communicate effectively on key functionalities and changes

3.3 Contractor & Design Proposal Evaluation

Managing RAMS within one's own organisation is quite different from managing RAMS from a distance in a contractor's premises. The engagement of a competent and responsible contractor is critically important. Whilst cost is always a major factor in contractor selection, the technical aspects can become overriding concerns for safety or service critical systems. The Corporation adopts a vigorous pre-qualification, tendering and vendor evaluation process which sometimes involves extensive pre-tendering audits and trials. During the project tendering phase the system assurance methodology focuses on the evaluation of potential contractors' capability, <u>for example</u>, in the following areas:

a. the comprehensiveness of their system assurance organisations and plans,
b. experience in applying system assurance to previous projects,
c. the accuracy and reasonableness of their claims of compliance with RAMS requirements,
d. the use of untried technology,
e. the anticipated performance of proposed designs, and
f. their understanding of the project requirements and appreciation of the Corporation's culture and practices.

3.4 Design Approval & Programme Control

During the design phase, the following risk and RAMS related engineering and management tasks are undertaken to ensure that the system assurance programme is under control, the issues that can potentially affect project performance are managed, and that the contractor gives adequate design attention to critical RAMS related issues:

a. Project Risk Management

This involves the systematic and comprehensive identification of uncertainties that may delay the project programme, increase the project cost or affect the technical viability of the project. The process covers all financial, contractual, regulatory and technical risk issues, as well as social / public issues, that are perceived to be significant and relevant. When the uncertainties are identified, the project team then puts in place risk controlling or reduction measures and allocates responsibilities.

b. System Safety

The most important information in the management of system safety is the perceived hazards and their control status. The main hazard information flow through the system design, construction, testing and operations stages are shown in Figure 3.

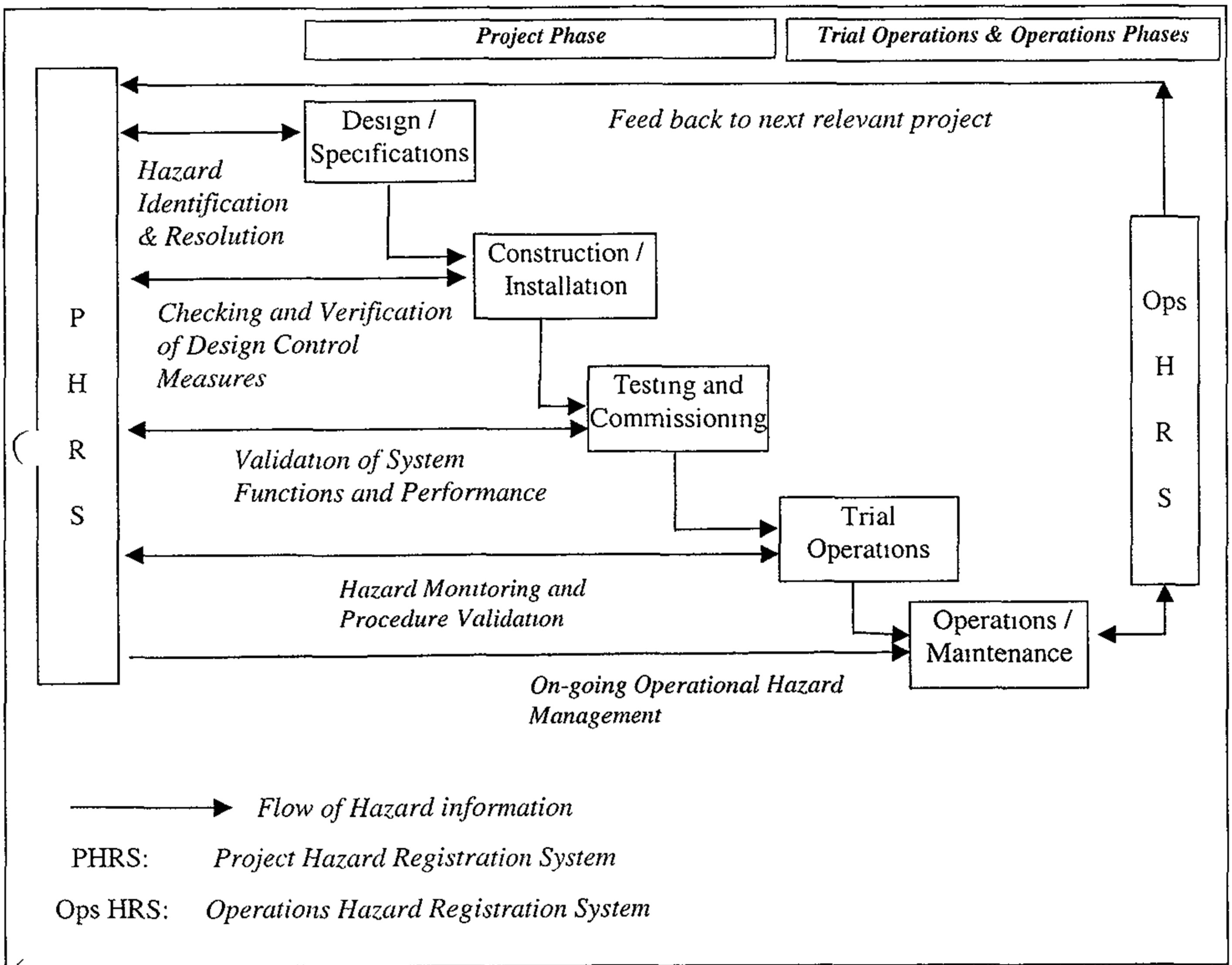


Figure 3 Hazard Information Flow for Managing System Safety

The first step of the process is the identification of reasonably foreseeable hazards arising from the installation, commissioning and through-life operation of the system. Adequate qualitative or quantitative risk analyses will then be performed to determine how, and with what frequency, systems could fail to function, what effects such failures will have, and how such failure effects could be mitigated effectively. Whilst the inherent safety of the system is of fundamental importance, it is also necessary to pay a lot of attention to how the installation and trial run of new equipment can possibly affect other existing railway equipment and services. The As Low As Reasonably Practicable (ALARP) principle [HSE, 1992] is applied in determining cost-effective risk reduction measures.

Hazard registration, reporting, monitoring and risk reduction actions are also undertaken in accordance with pre-defined plans and procedures. When the system is handed over for operations, the operational hazards remaining in the project hazard regieter (PHRS) are transferred to the Operating Railway's Hazard Registration System for on-going monitoring and control.

c. Demonstration of Case for Safety to the Railway Inspectorate

The Corporation has committed to the Hong Kong Government through the Operating Agreement that no new railway facilities will be open for public service until the Chief Inspecting Officer of Railway (usually known as the IOR) of the Hong Kong Railway Inspectorate is satisfied with the safety standard of those facilities.

The Corporation has chosen to demonstrate the case for major extensions or major upgrades in a structured manner, taking into account international best practices. The key steps to establish the case for safety are summarized in Figure 4.

First, the Corporation had put in place organization and arrangements to enable the systematic management of safety issues, hazard identification and control, and risk assessment / modelling as described above in this paper. The salient features of these arrangements and significant findings from the safety analyses were then summarized in the System Safety Report.

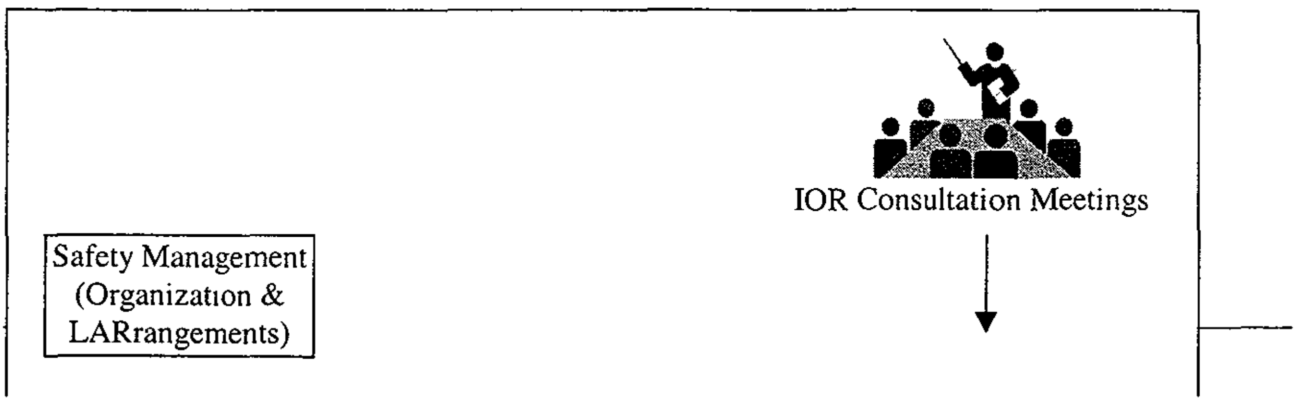
Parallel to the above, major design features and safety issues were discussed with the Railway Inspectorate in a series of IOR Consultation Meetings. A set of IOR Consultation working papers was also developed to facilitate the discussions.

The final stage included a series of on-site railway inspections conducted by the Inspectorate to observe, verify and test specific safety features and operational arrangements, with reference to the issues identified from the System Safety Report and in the Consultation Meetings.

Upon completion of all safety verification with the Corporation, the IOR reported his findings to the Secretary for Transport of the Hong Kong Government, endorsing that the railway was safe for public passenger service.

d. RAM (Reliability, Availability, Maintainability)

The emphasis of RAM requirements in the contracts is very much on the prevention (designing out), detection and correction of inherent reliability deficiencies. Depending on the nature of the system being designed / procured, techniques such Reliability Block Diagrams, Fault Tree Analysis, Failure Modes & Effects Criticality Analysis, reliability & availability modelling, reliability prediction and apportionment, maintainability design review and demonstrations etc are applied selectively to address specific parts or functions of the system. Reliability design criteria are established and fault tolerant designs are employed to cover critical parts of design.



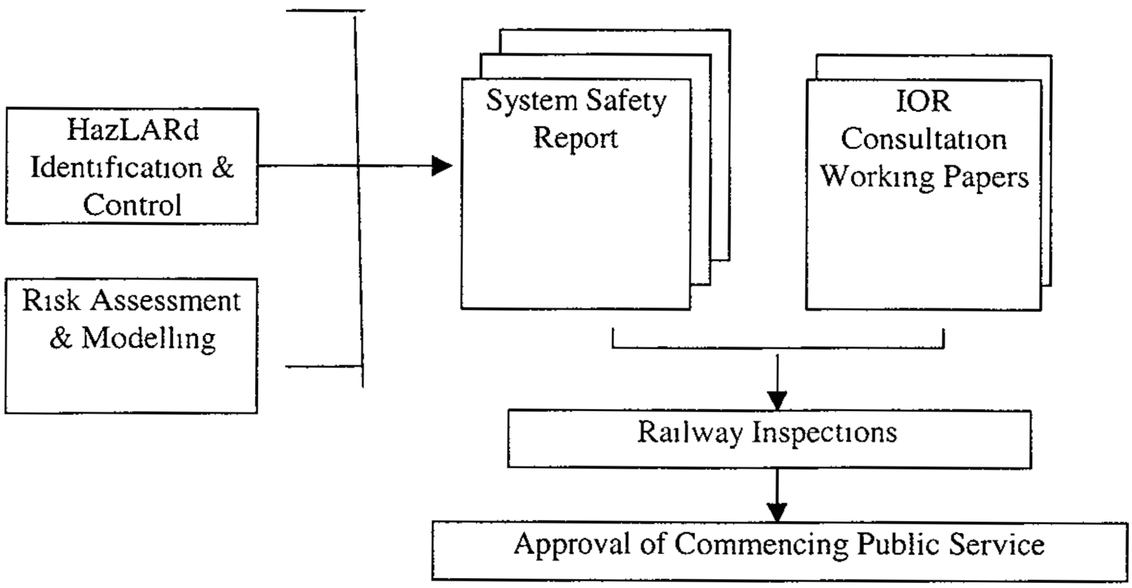


Figure 4 Demonstration of the Case for LAR Operational Safety To the Railway Inspectorate

Maintainability design criteria which cover parts interchangeability, accessibility of parts and test points, calibration needs, modularity, use of standard tools etc. are also specified. Mean Time To Repair and other numerical maintainability targets are set on the basis of service needs.

e. Maintenance Requirements and Support

Traditionally maintenance requirements are established on the basis of supplier's recommendations and in-service experience. When potential benefits outweigh costs, systematic maintenance analysis techniques such as Reliability Centred Maintenance are employed to establish maintenance tasks and frequencies for new and complex systems.

Maintenance support resource requirements such as skill, training needs, crew size, spares, maintenance facilities etc. must all be established well in advance to ensure that when the procured system goes into operational service it can be operated and maintained in its intended operating environment.

f. Operability & Service Recovery

The system assurance methodology emphasizes the importance of involving the operators from the very early stages of design to ensure that operational requirements and human factors receive adequate attention. Formal ergonomics and human reliability assessments may be carried out to analyse significant man-machine interface issues. Design features and procedures that control hazards, respond to emergencies, enable speedy service recovery following incidents or failures are also given early consideration in the design process.

3.5 Verification and Validation

In order to avoid costly redesign and rework and to minimize early in-service failures, comprehensive off-site testing during the project design and commissioning phases must be conducted to:

a. identify deficiencies in design, material and workmanship as early as possible,
b. identify effective improvement measures,
c. check compliance with all requirements, and
d. determine operational service readiness.

The system assurance framework provides guide-lines for calling up, on selective basis, physical and configuration verification, environmental tests, endurance tests, simulated-use tests, burn-in tests and pilot station tests / trial operations to complement standard system development and integration test work. When on-site testing is performed, contingency measures must be in place to minimize potential interruptions to existing railway services in case that failures occur.

3.6 System Performance Monitoring

Systematic data collection, reporting and analysis methods must be established prior to the operation phase for

a. monitoring performance and identifying improvement needs during the defect liability period, and
b. monitoring performance and supporting improvement and replacement decision making during operational service.

A typical performance monitoring method consists of the following activities:

- establish organisation and responsibilities
- determine input data requirements
- collect and record data in accordance with established procedures
- report RAMS performance periodically and highlight significant achievements and major problem areas
- analyse failures to determine causes of failures
- identify improvement measures and implement them in design, manufacturing, operation or maintenance processes

4. LESSONS LEARNT FROM APPLICATIONS

The ISA framework has evolved from experiences in the applications of the system assurance process for different projects in MTRCL.

More noticeable recent applications of the methodology included:

- The new Airport Railway (comprising the Airport Express Line and the Tung Chung Line) which was opened in 1998 [Kam, et al 1999, Ng, et al, 1998]
- Retrofitting platform screen doors (PSD) to existing underground stations
- Station improvement works (improving accessibility, passenger flow and control rooms)
- Environmental Control System and Power Remote Control system upgrade works

- Station public announcement system upgrade works
- Additional of new running lines to the Airport Railway to accommodate future growth of patronage
- Study of automatic turnaround system
- Improvement to the procedure for detrainment in tunnels [Kwok & Ng 1999]

The above applications have verified the applicability and usefulness of the ISA framework and have provided experiences that enabled continuous improvement to the approach. Some key issues are summarised below:

4.1 The Scope of Application

It was found that the methodology is not only useful in asset modifications, it was also useful in managing changes in operational practices (such as the detrainment procedure) and in supporting the development of new systems (such as the automatic turnaround). In effect, the ISA framework provided a structured methodology to manage the operational changes in railway system, whether the changes are adding a new extensions or upgrading an existing system.

4.2 Line Management Buy-In

It is important that the project management team, the future operations team have a good understanding and agree on what the ISA framework will achieve and deliver to them. This will create commitment to the application of the methodology and in turn, will lead to more effective and efficient delivery of the projects that meet the original requirements. The understanding and confidence in the methodology will also avoid duplication of efforts when different parties attempt to ensure that their requirements are met.

One effective way to create such buy-in is to conduct periodic in-house briefings for project team members on the rationale and approach of the process.

4.3 Progress Needs to be Assured

The various system assurance tasks produce most value when they are conducted at the correct time. To improve the timing of the actions and the necessary contract control, milestone audits of critical projects will also be linked to the completion of some of the system assurance tasks. This will ensure that system safety be considered at the right stage of the project and improvement introduced at the most cost-effective way.

4.4 Transfer of Hazard Control During Hand-over

When a project moves from testing and commissioning to operations, the responsibility for controlling the assets and their risk reduction measures is also handed over. For large systems, this hand-over may span over a long period of time. To prevent gaps in the continuity of responsibility from appearing, a more structured hand-over arrangements for the assets are being developed. The same will be applied to the hand-over of system safety matters.

4.5 Other Areas

The ISA framework continued to be strengthened with practical experience on the applications of the framework to different systems and works. Three further directions development in the pipeline include,

- a more focused approach to interface management
- a more comprehensive approach to software life cycle management

5. CONCLUSIONS

The system assurance methodology adopted by MTR Corporation Ltd. is a life cycle process. It provides a coherent and comprehensive framework for managing activities that have direct bearing on the initial as well as the long term RAMS performance of railway systems.

The integrated approach to system assurance emphasizes undertaking system assurance tasks that match the needs of the system to be procured. To be effective such tasks must be performed during the appropriate phases of the system's life cycle, and they must be integrated with other design and manufacturing / implementation activities, and deployed in a cost-effective manner.

REFERENCES

Ball, D.J , 1996. Risk Management, Miller Freeman Information Services, KEMPE Engineers Year Book For 1996.

Cox, S.J. and Tait, N.R S., 1998 Reliability, Safety and Risk Management, An Integrated Approach, 2nd edition, Butterworth - Heinemann Ltd. 1998.

DEF STAN 00-40 Part 1, 1987. "Reliability And Maintainability - Management Responsibilities And Requirements For Programmes And Plans", 24 July 1987

Gaffney, P., 1999. Quality in the Fast Lane – Managing Railway Engineering – The MTR Experience Keynote Paper, 8th Hong Kong Quality management Convention, Hong Kong, March 1999

Health and Safety Executive, 1992. The Tolerability of Risk, Revised edition, HSE Books, 1992

Health and Safety Executive, 1996 Railway Safety Principles and Guidance, Part 2, Section A "Guidance on the Infrastructure", HSE Books, 1996.

Kam, Jacob C.P., 2000. Recent Safety Management Development in MTR Railways in Hong Kong Annual Conference of Australian & New Zealand Association of OHSE, Hong Kong, January 2000.

Kam, Jacob C.P., Lai, Ivan, 1999. Safety Assurance for New Extension Projects of the Hong Kong MTR Corporation. International Railway Safety Conference, Banff, Canada, October 1999.

Kam, Jacob C P., Ng, N.W.H., Chow, O.L., 1999. Assurance of System Safety for MTRC Extension Projects. System Safety Seminar, Hong Kong Institution of Engineers, March 1999.

Kwok, J., Ng, N.W H., 1999. Application of System Assurance Techniques on Tunnel Evacuation Procedure and System Operability Review. Int Conf. Escape from Tunnel, ITC, Lyon, France, May 1999.

Lai, I.C.K , Ng, N,W.H , 1999 Assurance of System Safety For the MTR Operating Railway System Safety Seminar, Hong Kong Institution of Engineers, March 1999.

Lee, G.K.W., 1996. Development of a Risk Control Process for Mass Transit Railway. International Railway Safety Seminar, South Africa, October, 1996

McCusker, A., 2000 Commercial Oriented Systems Engineering in the MTR Corporation Ltd., Int. Conf. COMPRAIL, 2000

MIL-STD-785B, 1980. "Reliability Program For Systems And Equipment Development And Production", 15 September 1980

Ng, N., Kam, J., BudgeReid, A.J., 1998. Managing Operational Safety in MTR Tunnels with a System Assurance Approach, Safety in Road and Rail Tunnels, Third International Conference Nice, France, 9-11 March 1998. Part 4: Operational Management No. 54, pp.601

Tong, D.K.W., 1995. Risk Management on Operational Railway, CL&P Safety Conference, Hong Kong, June 1995.

Acknowledgements

The authors would like to thank the MTR Corporation Ltd., Hong Kong, for permission to publish this article The opinions expressed in this article are those of the authors and do not necessarily reflect those of the Corporation The authors would also like to thank all their colleagues for their invaluable input to this article.

International Rail Safety Conference

2000 LONDON

8 November - 10 November 2000
Forum Hotel, London, United Kingdom

Paper 0026

Lim Poo Yam

Implementing Project Safety Review Process: The LTA Experience

Publisher
2000 International Rail Safety Conference

International Rail Safety Conference

Lim Poo Yam

Manager, Safety

Land Transport Authority of Singapore

Implementing Project Safety Review Process - the LTA Experience

IMPLEMENTING PROJECT SAFETY REVIEW PROCESS – the LTA Experience

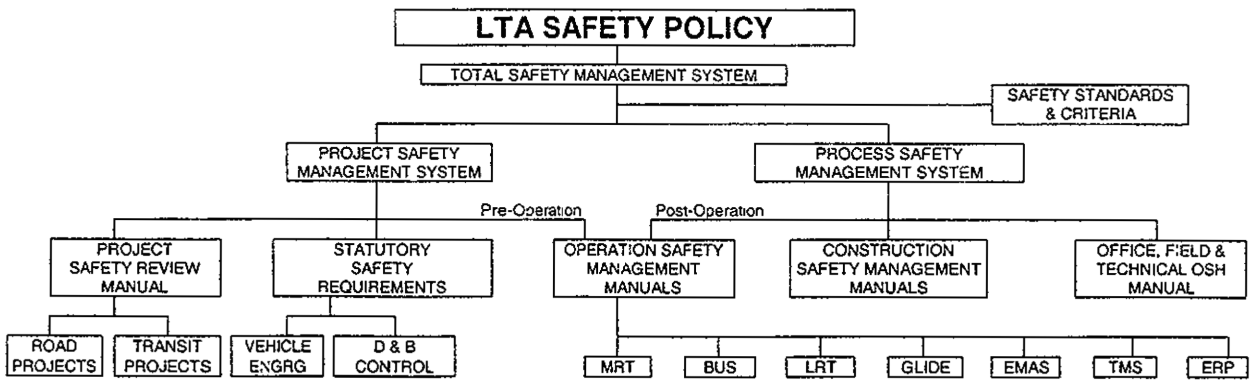
Lim Poo Yam
Manager, Safety
Land Transport Authority

1 INTRODUCTION

The Land Transport Authority (LTA) of Singapore was formed in 1995 from the amalgamation of the former Road Division of the Public Works Department (PWD), Registry of Vehicle (ROV), Policy Department of Ministry of Communication and the former Mass Rapid Transit Corporation (MRTC). The principal objective entrusted to the LTA is inscribed in its mission statement, "to provide a quality, integrated and efficient land transport system which meets the needs and expectation of Singaporeans, supports economic and environmental goals, and provides value for money."

LTA is a unique organisation with its roles both as a developer as well as a regulator of land transport system in Singapore. The LTA management firmly believes in safety for its project staff, the operators' staff, the land transport commuters and the public in general. This is a tall order to achieve. In 1996, LTA decided to engage an external consultant to draw up an effective Safety Management System. Study on LTA as an organisation with its roles in delivering a world class land transport system was carried out with the help of the consultant. As a result, a formal structured process in achieving Total Safety was proposed and accepted.

TOTAL SAFETY MANAGEMENT PLAN



A systematic structured approach in ensuring safety was proposed under the name, Project Safety Review or PSR Process. Safety Submissions are required at four significant stages of a Project Life Cycle: at the Conceptual Stage, the Design Stage, the Hand-over Stage (completion of Test Running) and lastly, at the completion of Trial Running but before the commencement of Revenue Service Operation. Similar process was adopted for Road and Rail projects with slight differences (Please see next page – Chart 1 & 2 for more information).

CHART 1 – SAFETY SUBMISSION FOR RAIL PROJECTS
SUMMARY OF CONTENTS, SCHEDULES AND ROLE PLAY

Items	Concept	Design	Testing and Commissioning	Trial Running	Remarks
1 – Safety Submissions	Concept Safety Submission (CSS)	Design Safety Submission (DSS)	Handover Safety Submission (HSS)	Operation Safety Submission (OSS)	
2 – Typical contents of Safety Submission to Safety Department	SMS, HAZOP, PHA and HL	SMS, SSHA, IHA, OSHA, FMECA, FTA and HL	DHA, OSHA, T&C Plan/Record Inspection Reports, O&M Manual and HL	SMS, OSHA, O&M Plan, SOP and Trial Running Plan	
3 When should submissions be made to Safety Department	Before contract award	Within 1 month after FCDD	At least 1 month before scheduled handover to Operator	1st draft 12 months before Trial Running Intermediate draft 6 months before Trial Running Pre-final version 1 month before Trial Running Final version Just before Revenue Service	
4 – ROLE PLAY					
4 1 – Submitter	System Assurance Group (SAG)	System Assurance Group (SAG)	System Assurance Group (SAG)	System Operator through Public Transport Regulation Office	*SAG reviews, integrates and collates submissions from contractors and prepares overall Safety Submissions*
4 2 – Auditor	Safety Department	Safety Department	Safety Department	Safety Department	*SD audits overall Safety Submissions including Safety Assessment report*
4 3 – Endorser	PSR Committee	PSR Committee	PSR Committee	PSR Committee (if necessary)	
4 4 – Arbitrator	-	PSR Executive Committee	PSR Executive Committee	-	
4 5 – Final Certifier	-	-	Chief Executive	-	

CHART 2 – SAFETY SUBMISSION FOR ROAD PROJECTS
SUMMARY OF CONTENTS, SCHEDULES AND ROLE PLAY

Items	Preliminary Design	Detailed Design	Pre-opening	Existing Roads	Remarks
1 – Safety Submissions	Preliminary Design Safety Submission (PDSS)	Detailed Design Safety Submission (DDSS)	Pre-opening Safety Submission (POSS)	Operation Safety Submission (OSS)	
2 – Typical contents of Safety Submission to Safety Department	• Independent Safety Review Report • Design Department's response and recommendation	• Independent Safety Review Report • Design Department's response and recommendation	• Independent Safety Review Report • Design Department's response and recommendation	• Independent Safety Review Report • Traffic Management's response and recommendation	
3 - When should submissions be made to Safety Department	Before Land Recovery is finalised	Before calling tender	Before opening of new roads to the public	Target Expressway – once every 5 yrs Arterial Roads – once every 10 yrs	
4 – ROLE PLAY					
4 1 – Submitter	Design Department	Design Department	Road Project Department	Traffic Management Department	*For PDSS Independent Safety Review are formed within LTA,* *For DDSS & POSS, external consultants are invited*
4 2 – Auditor	Safety Department	Safety Department	Safety Department	Safety Department	
4 3 – Endorser	PSR Committee	PSR Committee	PSR Committee	PSR Committee	
4 4 – Arbitrator	PSR Executive Committee	PSR Executive Committee	PSR Executive Committee	PSR Executive Committee	

2 IMPLEMENTATION IN THEORY

2.1 Establishing the Ground Work, Organisational Set-up

LTA recognises that it has two significant but distinct roles to play. On one hand, as a network developer, it has to ensure that a Mass Rapid Transit (MRT) or Light Rapid Transit (LRT) Project is safe to develop and deliver, and can be operated safely. On the other hand, as a regulatory body for the public transport operators, LTA scrutinises them to ensure that there is an organisational structure and process in place to operate the Systems safely.

In September 1997, a seminar was organised by the Safety Assurance Department to launch the LTA's Safety Policy, during which the Chief Executive made a formal declaration of the Safety Policy.

System Assurance Group (SAG) was formed in 1998 under the office of the Chief Engineer, Systems. The department is entrusted to provide System Assurance services to the Project & Engineering Division, the responsible division for the implementation of rapid transit and road projects. To have an acceptable degree of independence, the SAG does not report to the Project Director but act as his advisor on System Safety matters.

To ensure public commuter and staff safety, the Operators are obliged by Licence and Operating Agreement (LOA) to implement a sound safety management system, subject to regular audits by LTA through the Manager of Public Transport Regulation (MPTR).

In May 1999, in conjunction with the overall organisational restructuring plan, Safety Department (SD) was formed; the Construction Safety Department was combined with the Safety Assurance Department. A new division called the Contracts and Process Division was formed, to which Safety Department reports, to ensure independence for effective check and balance purposes.

2.2 Establishment of the Rules, launching the PSR Manual

In August 1999, the LTA management instructed Safety Department to prepare Project Safety Review Manual to clearly define the requirements of the PSR process. A clear review, audit and approval hierarchical set up was established in line with the latest organisational set up.

The SAG group will play the role of reviewer and submitter, responsible for reviewing, collating and integrating individual system discipline's safety submissions into the System Safety Submission. The System Safety Submission comprising SAG's independent safety assessment report, hazard logs with details of hazard analysis and risk assessment, mitigating and close-outs are then submitted to the Safety Department for audit purposes.

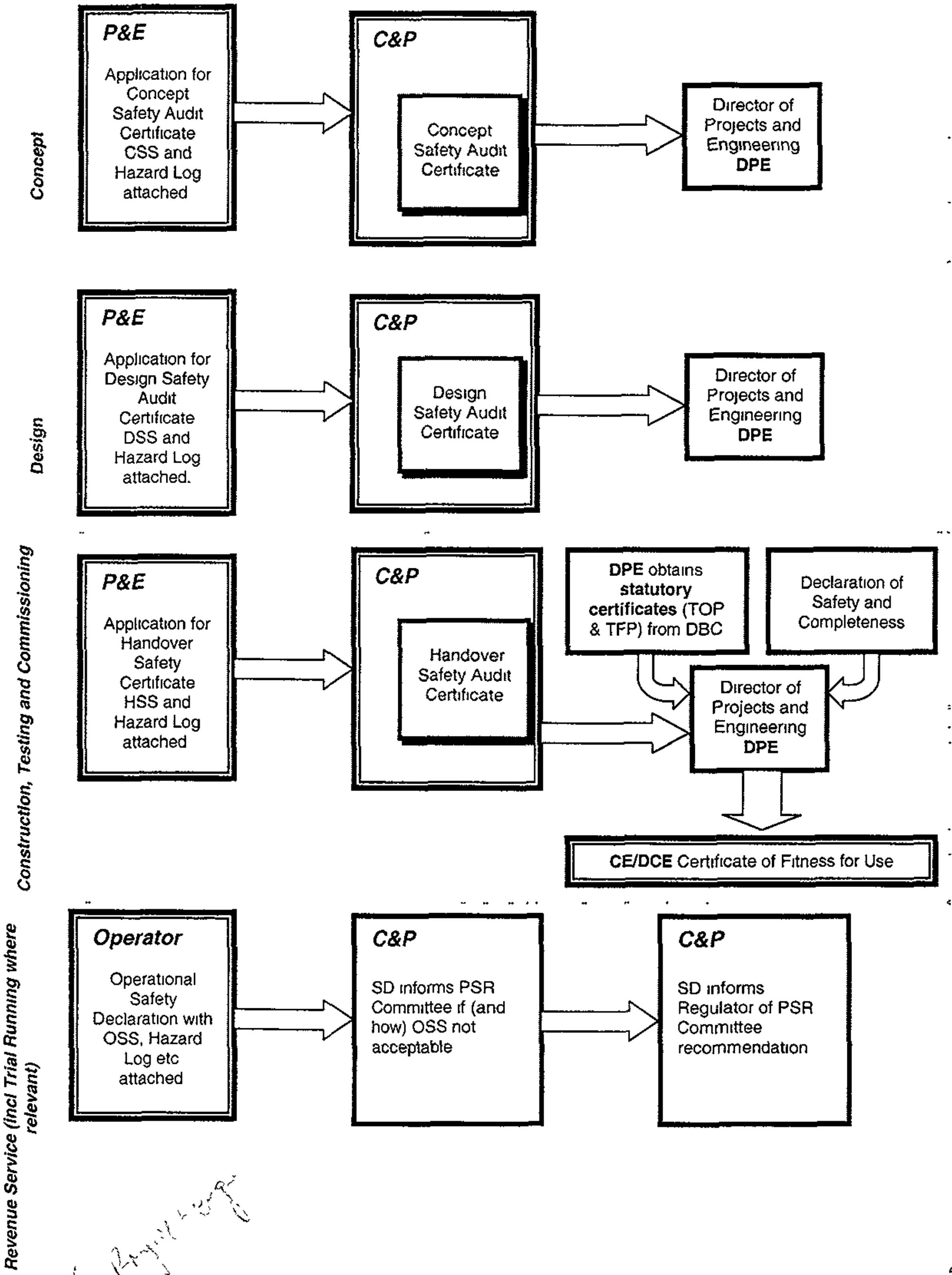
The Safety Department will audit the safety submission focussing on Hazard Analysis and Risk Assessment and Mitigation Process. The Hazard Log is the fundamental document referred to. Quantitative Risk Analysis applying the Fault Free Analysis methodology will also be audited. Upon completion of audit, Safety Department will present the audit findings in the form of an Audit Report to the PSR Committee for endorsement.

A PSR Committee chaired by the Director of Contracts and Process, made up of members from the Chief Engineer System, Chief Engineer Civil, various Project Directors and the MPTR will deliberate, and attempt to resolve, any disagreement on safety assessment between the SAG and SD. The PSR Committee could call for the formation of Technical Working Group to assist in resolution of technical matters.

At the highest level, a PSR Executive Committee chaired by the Chief Executive, made up members from the various Directors will evaluate, and endorse, any effective proposals from the PSR Committee. The Executive Committee also provides overall leadership and direction for the Project Safety Review process in LTA.

This organisational set up is aimed at giving LTA a certain degree of confidence in ensuring that safety issues are dealt with not only in a structured manner, but in a manner where effective checks and balances are inherent in the process (Please refer to diagram below)

SAFETY CERTIFICATION PROCESS FOR RAIL PROJECTS



3 THE STRUCTURE OF PSR PROCESS

3.1 System Conceptualisation Stage

Right from the start of Concept development, hazard identification and risk assessment for the new line will be undertaken. Mitigating factors taken at the stage is the most cost effective. Safety Submission called Concept Safety Submission demonstrating that the adopted alignment and selected System will achieve the Level of System Safety declared. System peculiarity and its performance are studied against the selected route vertical and horizontal alignment constraints, its environmental conditions in terms of possible interference. CSS demonstrates that the adopted Design Concept is able to achieve the Project Safety Targets set.

To be effective, for Rail Projects, the Concept Safety Submission (CSS) must be made and accepted before the award of System Contracts.

For Road Projects, Preliminary Design Safety Submission has to be submitted before land acquisition is finalised.

3.2 System Design Stage

During the Design Stage, every system discipline comprising train, signalling, communication, power supply, supervisory & control system and others undergo a process of thorough hazard identification and analysis right to the lowest replaceable units (LRU). Risk assessment is carried out as part of Reliability, Availability, Maintainability and Safety (RAMS) study. One month after the completion of the Final Design, a Detailed Design Submission (DSS) will be submitted by, or through the SAG to the Safety Department.

Hazard and Operability study or commonly called HAZOP is carried out. HAZOP as a brainstorming session could be carried out in two ways, a top down approach and a bottom up approach. The top-down approach starts with identification of commonly known hazards and works its way down to find out what could trigger such hazards. It has limitations, as it relies heavily on the experience of the participants in the HAZOP sessions. The approach basically sees the "Big Pictures" but may inadvertently miss some important details.

The more time-consuming bottom-up approach based on systematic "walk through" of safety critical system design is more rigorous. It employs key words such as "higher than" or "lower than" specified intended performance to test the result system response to such "perturbation". This approach is more effective as it makes no assumption of inherent safety features of system design. Conversely, this approach may end up "lost in the forest", paying too much attention to details and missing the overall objectives.

Typically, at the Design Stage, identified hazards for individual system discipline must be effectively closed out either by design or by proposed operational procedures. The system designers are expected to demonstrate how identified hazards are mitigated to an acceptable level using the ALARP principle by the Quantitative Risk Analysis method such as Fault Tree Analysis and Event Tree Analysis. Nevertheless, qualitative approach using Failure Mode Effects and Criticality Analysis (FMECA) in demonstrating compliance with specified design criteria cannot be omitted. It is one of the critical aspects of the safety analyses. The FMECA is in a bottom-up analysis process in the identification of top-level hazards.

To demonstrate acceptability of the adopted design approach in closing out identified hazards, designers are required to carry out theoretical calculations or computer simulation. However, this is not conclusive. They are expected to devise effective test plans to verify the specified system functionality, and to validate the system performance against the specified performance target, to closeout the hazards.

Each system discipline contractor is expected to carry out Risk Assessment to prove that the subsystems stand-alone and in interfacing with other systems function safely even in the event of any failure.

If Risk Management is defined as Loss Control of Accidents, then to reduce the risk exposure, two critical areas of management are:

3.2.1 Probability of the hazard occurring or failure rates of systems/subsystems that triggers such occurrences. If the probability or failure rate is high, designers could review:

- i the use of higher quality of material;
- ii the use of available technology for matching interfaces;
- iii the duplication of subsystems to provide redundancy.

3.2.2 Severity assessment on the consequence of the identified hazard. If the designer is unable to reduce the probability of hazard occurrence, for example, a train fire within a tunnel section, he should/could reduce the severity exposure by taking protective measures against injuries. Tunnel ventilation fans are used to lessen asphyxiation due to inhaling toxic smoke. The Operator could plan and hold regular emergency preparedness drill to ensure expeditious rescue and recovery actions are in place when any need arises.

Nevertheless system constructability and maintainability must not be compromised in pursuit of hazard close out exercise. PSR excludes construction safety, because there are legal requirements under the Factory Act governing safety practices on construction sites. The Safety Department's Registered Safety Officers (RSO) in the Construction Safety Section undertake the roles of Safety Auditors.

For Rail Projects Design Safety Submission must be submitted within one month after the Final Design Document Delivery.

However, for Road Projects, Detailed Design Safety Submission has to be submitted before construction contracts are called. Issues examined during this stage are potential hazards of vehicle to pedestrian, vehicle to vehicle, vehicle to road side structure, collisions. Mitigating factors such as effective traffic management, safety barrier, improvement alignment and visibility are normally applied.

4 TESTING AND COMMISSIONING STAGE

Testing is a critical continuation of the Design Stage. Not only compliance with the Design Criteria demonstrated by calculation and simulation will be put to test during the Testing stage, but more importantly, the achievement of effective close out of hazards must be demonstrated at every system discipline level as well as at the overall System Integration level. Though Fail Safe design principle could be demonstrated effectively by testing, it is impractical to verify the specified rate of failures, as it takes time.

For a typical rapid transit project, testing commences with the "Power On" exercise, during which system electrification takes place. It allows the entire railway system to be tested first at each station and then finally, complete line integrated with the Operation Control Centre.

Safety aspect of "Power On" is traditionally entrusted under the responsibility of the Licensed Electrical Worker (LEW). Electrical fault if not cleared quickly and effectively would normally result in property damages and fatalities caused by explosion or fire. Proper discrimination of protective relay settings to clear calculated or expected fault levels would alleviate such hazards.

Properly documented checklists are referred to ensure all safety aspects are checked before track supply in the form of third rail DC power is turned on. Track surveying for identifying infringement into railway envelope, checking of track alignment to third rail and track geometry, completeness of work with the station platforms, and adequacy of general security and escape routes, availability of Fire Protection system, are some of the critical items on the checklist.

Once DC power is turned on, functionality of Emergency Trip Station (ETS) circuitry is checked to ensure that it could be relied upon when an emergency arises. Line sectionalisation and provision of an uninterrupted communication channel to the control centre are the key criteria of an effective ETS system.

With all the mechanical and electrical services being checked under the statutory requirement, especially fire protection, train related Test Running with the objective of dynamically integrating the trackside E&M systems begins.

Trains are first tested on Test Tracks before they are used for Test Running on the depot and mainline tracks. The Test Track is designed with all the basic features and functionality for signalling, communication and power supply. It provides a test-bed for verifying the basic functionality of train to signal, communication, and power supply system interfaces. A train that has successfully undergone Test Track testing is termed as a "Tested Train".

While preparation for the Dynamic Integrated System Test, (commonly called Test Running in Singapore) Static Integrated System Tests will be carried out in parallel. Signal Equipment Room (SER) testing linking up with track circuit testing through Signalling Junction Boxes located along the trackside.

Fibre-optic network designed for Data Transmission linking station to station and to the Operation Control Centre has to be commissioned to provide the critical communication backbone, to ensure that all commands, status monitoring data including alarms are integrated and controlled accurately via the Supervisory and Control System

The principle and rigour of systematic elimination are adhered to, to ensure that System Safety is assured progressively before the next interface is tested and commissioned.

4.3.1 Test Running Process

Test Running begins with the running of a Tested Train on a mainline section. Signalling and communication testing intertwines with each other for the slow speed single-train test. Signalling tests ensure that the general track geometry such as block lengths, breaking distances, door opening on the correct side, route locking, are verified. Data gathered are studied and adjustment made to the database. During that time, testing of communication system for data transmission and radio communication is verified. The process is repeated with increasing train speed till testing under designed speed is successfully completed.

When effective Automatic Train Protection (ATP) and Radio Communication are established, it is then considered safe to proceed to test Automatic Train Operation (ATO) with train running at designed speed. Automatic Train Supervision (ATS) for fleet monitoring, service regulation and route selection are tested via the Operation Control Centre. More trains will be introduced progressively to test the achievement of designed headway route setting and interlocking.

Towards the last quarter of the Test Running Period, when most systems have been tested and with train fleets able to perform at the specified performance level, tests to verify the system susceptibility to electromagnetic interference (EMI) are carried out.

Finally, non safety related tests such as Train Ride quality, Power System Load Shedding/Sharing and regenerative brake features are performed to complete the Test Running period which signifies that the complete Railway System is technically safe, and complies fully with contract specifications.

For Rail Project, Handover Safety Submission (HSS) must be submitted to the Safety Department, at least two weeks before the end of Test Running. An Audit Certificate for the HSS submission together with all the Temporary Occupation Permits (TOPs) have to be issued by the relevant departments before the Systems is declared "Fit for Use", to be ready for the Operator to commence revenue service operation.

For Road Project, the Pre-opening Safety Submission (POSS) is made by the Road Project Team. It comprises Safety Review Report by an external consultant, the project team's response and recommendation. POSS is made and its endorsement must be obtained before new roads are open for public use.

5 TRIAL RUNNING PRIOR TO REVENUE SERVICE OPERATION

Trial Running begins after Test Running is completed. It is a Trial Operation where various modes of incidents are simulated to test the emergency preparedness of the operating and maintenance staff. They will be tested on how to ensure the safety of commuters, and swift system recovery without compromising the staff's own safety. Adherence to documented Operation and Maintenance Procedures in minimising hazards will be verified.

Under the PSR process, the appointed Operator must demonstrate to LTA that he has a system and organisational structure in place to operate the Systems safely Such demonstration is evidenced by the submission of the Operation Safety Submission (OSS) The Operator is required to submit to LTA Safety Submissions 12, 6, 1 month before the commencement of Trial Running, to progressively prepare for the readiness of System Operation A final Safety Submission will be submitted subject to the Regulator's acceptance before Revenue Service can commence.

In the Safety Submission, the Operator must show that he understands the seriousness of identified hazards, and possesses written procedures for his operating and maintenance crews' strict adherence in ensuring safety.

Hazards that could not be effectively closed-out by design must be handled by practical procedural control. Others that are mainly operational in nature will have to be analysed under Operation Support Hazard Analysis. One of the key packages of Operation Safety Submission is the Trial Running plan. The plan must demonstrate that the Operator understands the known hazards and that he has devised realistic simulated scenario that would be effective in testing out the readiness of his staff

6 IMPLEMENTATION IN ACTION

The PSR Manual for Rapid Transit System Project was approved in May 2000 and formally launched in Jul 2000. The Electric Train Contract was the first to undergo the PSR process.

6.1 Electric Train Contract

No Design Safety Submission was made as it was considered too late to do so, only the Hand-over Safety Submission was submitted based on evidence of findings from testing and commissioning.

The Contractor attempted to justify the achievement of this set target by a combination of qualitative FMECA and quantitative Fault Tree Analysis. Safety Department's audit focussed on:

i Train coupler operation, failure or dislodged by deliberate attempt;
ii Detrainment door operation, failure or deliberate forced opening;
iii Fire or smoke control for in-car or under-frame fire;
iv Train braking system;
v The integrity of zero velocity relay

Quantitative analysis based on failure rates of component or subsystem is based fundamentally on reasonableness. The data quoted by the Contractor could not be verified, as there is no established commonly agreed databank to tap from.

Interface hazard analysis was also not done conclusively, as the contracts did not spell out clearly who is to lead in and be responsible for such analysis.

Though Safety Submission for train fleets could be made to demonstrate achievement of safety target set after they have undergone Test Track Testing, many interface hazards and their susceptibility to EMI could not be verified and validated until Mainline Test Running is completed. A separate Safety Submission forming an integral part of the overall system is should be submitted.

6.2 The Changi Line Extension Project

Changi Line Extension Project (CAL used as an acronym) is a 7 km spur line from the existing Tanah Merah station towards the famous Changi Airport. There are two stations built under the extension project namely, the EXPO station and the Changi station. The extension will be opened in two phases, the first up to EXPO station by end of 2000 and the second phase completes the project in last quarter of 2001.

CAL is the first MRT line subject to PSR. Its design is fundamentally similar to the existing line that has been running for the last 13 years. Even the system contractors are those engaged for the construction of the existing line. No quantitative "level of safety" target was set for CAL at overall System level. The project team therefore takes the position that it is inappropriate to carry out Quantitative Risk Analysis.
The Design Safety Submission is currently being audited, and Hand-over submission is being prepared and will be audited during the last quarter of 2000.

Because of the similarity with the existing line, as long as it is as safe as the existing line, it is considered safe and acceptable. Even though hazop was carried out regimentally, the Project team decided to adopt the traditional deterministic approach of compliance to good practices for Safety Certification criteria.

The lessons learnt are:

i Severity assessment cannot be relied on judgement of a few professionals, it ought to refer to research done based on accident investigation or computer simulation based on various train loading capacity.
ii Probability of failure or failure rates must be based on established common database agreed in the international rapid transit system developer and operator community.
iii An international forum to share knowledge and experience of performance of certain product range by certain suppliers
iv Establishment of an acceptable "cost of accident" relating to value of life is difficult from many fronts, without which the As Low As Reasonably Practicable (ALARP) principle cannot be effective applied for the risk-based safety analysis.

6.3 The North East Line Project

The North East Line Project (NEL) was launched in 1996. There are 16 stations spreading over 20km of twin tracks starting from the HarbourFront station cutting across the city centre at China Town and Dhoby Ghaut at the famous Orchard Road district, towards the new towns of SengKang and Punggol in the North East. It is totally underground, with its stations all fitted with screen doors. NEL is scheduled for Revenue Service Operation in three stages in the 2nd half of 2002

The North East Line is new and unique in Singapore, in three ways: firstly, train fleet are running on power fed via the catenary system instead of the traditional third rail system, secondly, it is a driverless steel wheel, steel rail system, one of the first in the world; lastly the signalling scheme is based on moving block principle using trackside mounted wave-guide for transmission of signals.

Interfaces between the train pantograph and the catenary supported contact wires will pose serious hazard of electrocution in the event of an emergency evacuation resulting from a train collision or fire, where the commuters could walk over bare overhead lines scattered on the trackside To ensure a safe evacuation path, an instantaneous tripping circuitry to effect a zonal isolation of the OCS system will be implemented as a mitigation factor.

As it is a driverless system, availability of an uninterrupted communication must be maintained at all times for the Operation Control Centre to send clear, accurate information to panicking commuters. The reliance on intelligent software is unprecedented and hence, how to verify and validate safety critical software system becomes a major concern. Not only the software system be able to trap erroneous input command due to human error, it must also provide security protection against mischievous or malicious hackers.

The wave-guide technology operating in an environment filled with electromagnetic waves must also be able to withstand any perturbation caused by latest information devices working on short wavelength radio system.

6.4 The Marina Line Project

The Marina Line Project is currently in the tendering stage It is due for Revenue Service by end 2005 Overall safety performance target has been set for Marina Line (MRL). The system level target is further split under each system discipline or subsystems.

Full scale PSR process will apply to the MRL, right from Concept to Design, Hand-over and Operation, Safety Submissions will be made System contracts will be specified with requirement of rigorous hazard identification and analysis, risk assessment and categorisation. HAZOP, FMECA, Fault Tree Analysis and Event Tree Analysis to analyse and assess the risk exposure of commuters to those hazards will be required

6.5 SengKang Punggol LRT Lines Project

The SengKang Punggol LRT Lines (SPL) was a turnkey project launched in Jul 1998, after the Bukit Panjang LRT Line. The PSR process will start with Design Safety Submission scheduled for first quarter of 2001. All Systems except Automatic Fare Collection System were contracted under Contract C810

The SPL covers the Housing Development Board (HDB) new town of SengKang and Punggol in the north east of Singapore. SPL trains run on rubber tyres with side power rail and centre guide-rail. The SengKang and Punggol LRT Systems are scheduled to be in revenue service by end 2002 and 2004 respectively.

The potential hazards of this driverless Systems will be similar to the Bukit Panjang LRT Line on commuter and train fleet control during normal and emergency scenario, from the Operation Control Centre computers, heavily dependent on secured and intelligent softwares

6.6 Road Projects

Road Projects PSR process started as early as 1998, its PSR Manual was formally endorsed in February 2000. An external consultant was contracted to train our staff in Road Safety Review. A team of over 60 Road Safety Reviewers are available within LTA

To-date, a total of 35 Road Projects have successfully undergone the full rigour of the Project Safety Review Process. Savings have been achieved in identifying potential hazards early, during the design stages.

CONCLUSION

LTA as an organisation firmly believes in Safety. Project Safety Review process providing a structured framework for systematic hazard identification and analysis, risk exposure assessment has been adopted as our cornerstone for ensuring Safety. While much emphasis is placed on objective risk-based quantitative analysis, the deterministic approach for compliance to sound engineering practice and judgement cannot and will not be ignored.

To participate and help develop a common reliable database for international rapid transit Developers and Operators to tap and share their knowledge and experience would be a step in the right direction in pursuit of PSR process. Accident investigation reports, performance data collected during routine maintenance for the Singapore Network would be kept in a commonly accessible database for sharing between LTA and the MRT and LRT Operators.

Furthermore, LTA will take the lead and encourage the Singapore's two Transit Operators to be proactive in attending and organising System Safety training, seminars and conferences in the near future. In our commitment to enhance our safety culture, LTA has joined UITP and APTA as an active member, and in May 2000, a Memorandum of Co-operation with FTA of America was signed in Singapore.

International Rail Safety Conference

2000 LONDON

8 November - 10 November 2000
Forum Hotel, London, United Kingdom

Paper 0027

Ray Howe

Waipahi Train Accident: A Human Factors Case Study

Publisher
2000 International Rail Safety Conference

International Rail Safety Conference

Ray Howe

Rail Accident Investigator

Transport Accident Investigation Commission, New Zealand

Waipahi Train Accident - A Human Factors Case Study

INTERNATIONAL RAIL SAFETY CONFERENCE 2000
Human Factors In Rail Safety

Waipahi- A human factors case study

Ray Howe, Rail Accident Investigator
Transport Accident Investigation Commission
New Zealand

Paper to be presented at London, November 2000

1. Introduction

At about 0702 hours on Wednesday, 20 October 1999 Train 938, a northbound express freight, collided with Train 919, a southbound intercity express freight, which was stationary on the main line within station limits at Waipahi on the Main South Line.

The locomotive engineer of Train 919 was fatally injured and the locomotive engineer of Train 938 was seriously injured.

The two locomotives on Train 919 and the single locomotive on Train 938 were extensively damaged, as were a number of wagons and containers.

Causal factors included one locomotive engineer's misunderstanding of his track warrant limit and the limited effectiveness of the action taken by the operator and the regulator to minimise the possibility of such misunderstandings.

Recommendations were made to the operator and the regulator to address the safety issues identified.

That is the abstract from a report on a recent rail accident in New Zealand. It is terse and objective, as such abstracts are inclined to be. Beneath this terse objectivity are the human factors which set the scene for this accident. This paper looks at these factors, the possible defences that could have been in place to minimise their adverse affect, and the rationale for installing such defences.

2. The Operating system

The accident occurred on a single-track line operated by Tranz Rail Limited (Tranz Rail) under Track Warrant Control (TWC). TWC is a version of systems referred to as "dark territory" in the United States and "unsignalled line" in the United Kingdom and was based on a controlled system to ensure that only one train had a warrant authorising occupation of a section of the track at any time.

Track warrants were issued by train control officers, who dictated the necessary details over radio or telephone to locomotive engineers (LEs), who then wrote the details onto a prepared form and read them back as a check. When the train reached the limits of the track warrant, the LE was required to advise the train control officer and cancel the track warrant.

Tranz Rail's management of TWC was enhanced by the use of a Track Warrant Computer System in Train Control The computer programme did not allow issue of a track warrant if another warrant already existed for the same track section. To enable trains travelling in opposite directions to pass one another crossing loops were provided at regular intervals. To control such crossings train control officers stipulated conditions on the track warrant.

The method of carrying out a train crossing in TWC territory depended on the equipment provided to change the points. At Waipahi the points were operated by electric motors, and two position Colour-light Points Indicators were installed. Unlike signals, which gave instructions to LEs about whether they may proceed or not, points indicators only indicated the direction the points were facing. The authority to proceed was the track warrant.

At Waipahi the point indicators were approach lit. This meant that as a train approached, it passed over an insulated joint in the rails and activated an electrical track circuit that caused the indicators to light up.

For an approaching train a facing indicator showed 2 lights, one above the other. Once approach lit the following possible light combinations were displayed:

Display	**Meaning**
purple over red	points set for the main line (straight ahead)
red over purple	points set for the loop (diverging)
red over red	stop-points may not be properly set and locked.

Any other display or no lights displayed on approach indicated a fault.

3. What happened

Events preceding the accident included the interaction of 3 trains. The trains and movements were:

- Train 913 southbound under the control of a locomotive engineer (LE 1) to cross northbound Train 938 at Mataura before continuing south following a crew changeover.
- Train 938 northbound under the control of a locomotive engineer (LE 3) to Mataura to cross Train 913. At Mataura LE 1 took over Train 938 with a track warrant already issued to proceed to Waipahi and enter the loop to cross Train 919.
- Train 919 southbound under the control of a locomotive engineer (LE 2) with a track warrant to proceed to Waipahi and enter the main line to cross Train 938.

Mataura is 38 km south of Waipahi

Train 919 arrived at Waipahi a few minutes before Train 938, entered the main line at Waipahi with a valid track warrant and stopped awaiting a crossing. Train 938 entered the main line without a valid track warrant at high speed and collided with Train 919 at approximately 62 km/h. Train 938's high speed entry into the main line at Waipahi was based on LE 1's understanding that he had a track warrant to Clinton, a station some 16 km north, to cross Train 919.

Figure 1 shows the relationship of localities to the planned crossing. Figures 2 and 3 show train movements and the site layout in sufficient detail to allow appreciation of the human factors involved.

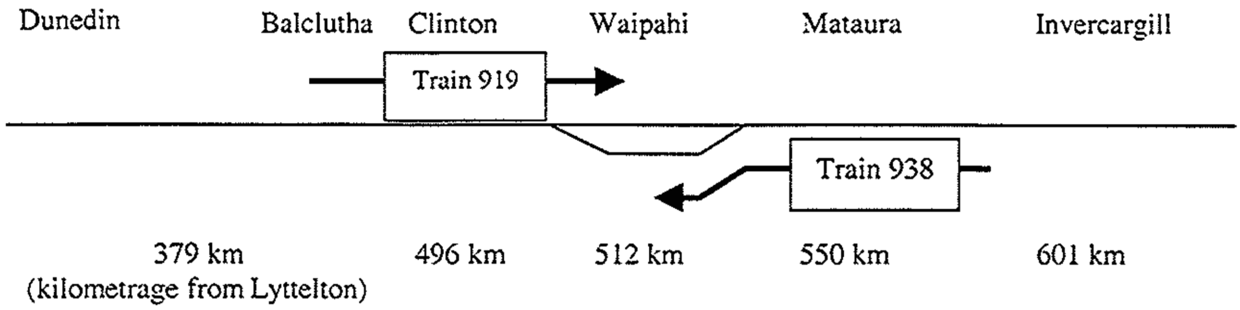


Figure 1
Relationship of localities to the planned crossing

4. Human Factors

With that general overview of the operating system and events of the day I will now focus on 3 active[1] failures and a number of associated latent[2] failures with specific human factors significance.

Active failures

1. The LE of Train 919 was required by regulation to set the south end points for the approaching train to enter the loop. However he stopped his train well short of the south end control box controlling entry to the loop and made no attempt to leave his train as he waited some minutes for Train 938 to arrive.

   The objective of setting the south end points was to facilitate berthing the second train on its authorised track, and not for opposing train protection. However, had LE 2 stopped Train 919 at the south end of Waipahi and set the points for the opposing train into the loop, he would have provided 3 possible defences against the collision occurring despite the misconception of LE 1:

   - LE 1 may have noticed the facing points indicator showing his route was set for the loop and slowed or stopped Train 938.
   - LE 1 would have seen Train 919 earlier, possibly in time to stop his train.
   - If Train 938 had not stopped it would have diverted into the loop.

[1] Failures committed by those at the "sharp end", having an immediate impact upon the integrity of the train.
[2] Failures originating in the managerial and organisational spheres, whose consequences may lie dormant for long periods.

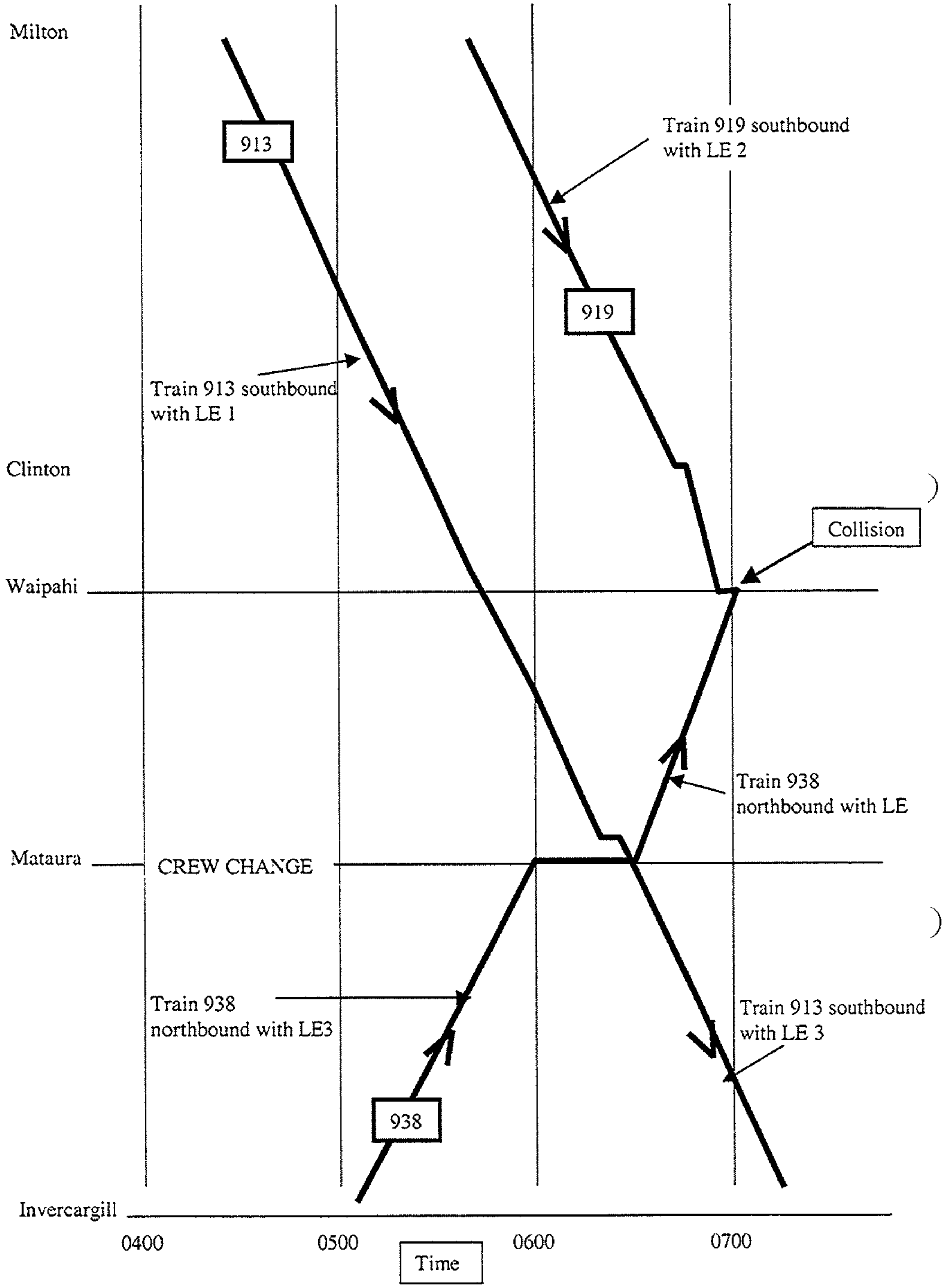


Figure 2
Simplified Train Control Diagram

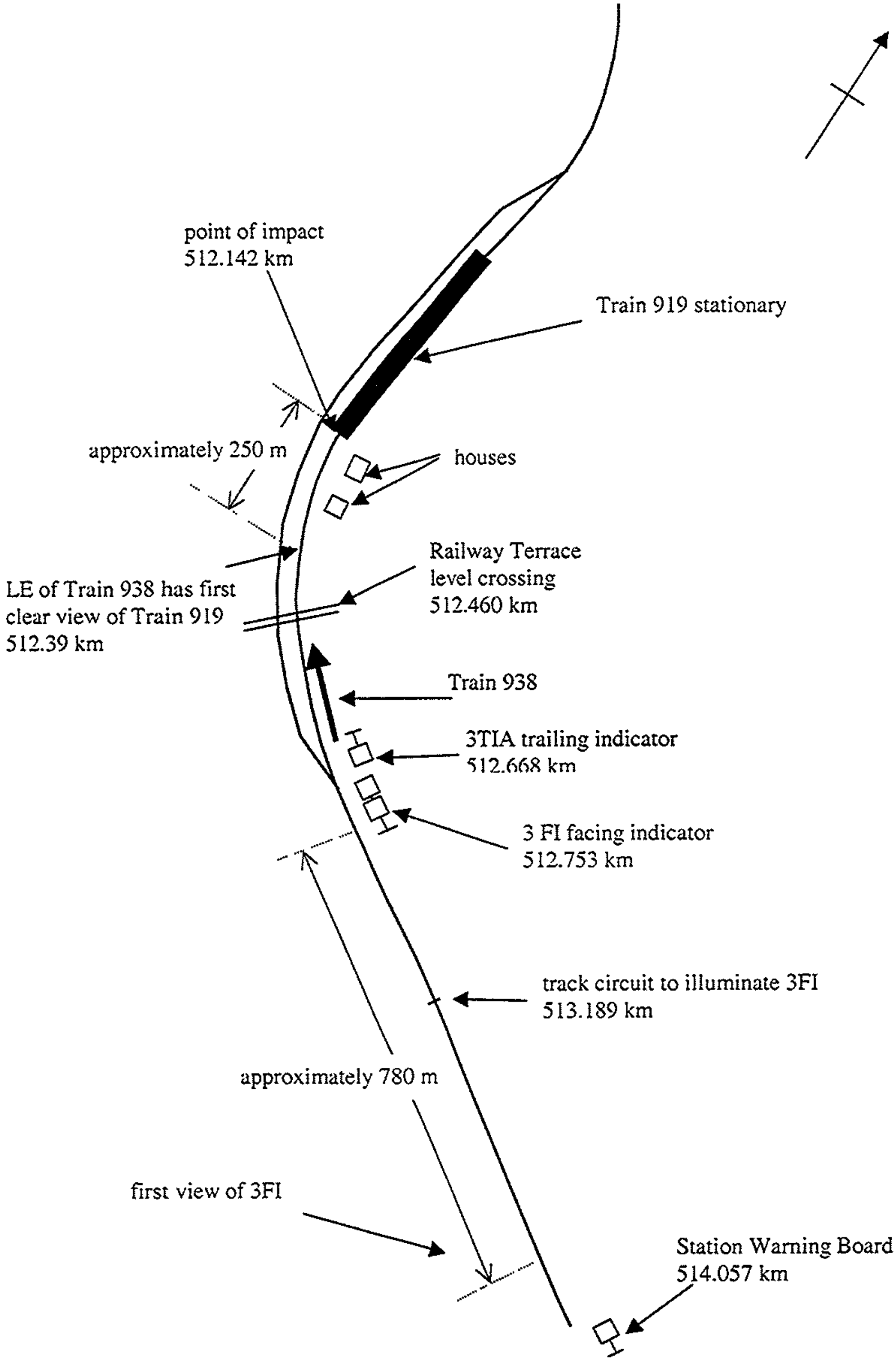


Figure 3
Waipahi Site Plan
(not to scale)

The investigation established that it was not uncommon for LEs of trains arriving on the main line first to pull up short and deliberately not set the points for the next train. A number of reasons were given for these violations including:

- a passenger train stopping at a platform
- to avoid noise in an urban area
- to avoid standing over a level crossing

Staff at all levels were not surprised by this variable interpretation of a mandatory operating regulation.

This raised 2 important issues. The first was that recurring deliberate breaches of the Regulation without appropriate authority were not detected. The second was that the failure to detect and correct violation of this Regulation undermined the resilience of the approved safety system by the message it gave to locomotive engineers that variable interpretation of mandatory regulations was acceptable.

2. The LE of Train 938 entered a section of main line which was not included in his track warrant limit He was controlling Train 938 according to his belief that he held a track warrant for a crossing at Clinton and not Waipahi, although when and how he came to this belief was not able to be determined.

A combination of factors may have contributed to LE 1's misconception that he had a TW to Clinton including:

- The failure of the crew changeover procedures to provide a defence against misheard or misunderstood track warrant details.
- The failure of the crew changeover procedures to strongly imprint the correct track warrant limits into LE 1's awareness to the level achieved by the repeat-back procedures with the TCO.
- Although it was agreed by all staff interviewed that it was the responsibility of an LE to read his warrant and know his limits it is highly likely that LE 1 did not read the warrant he inherited. A warrant inherited in this way was termed a conditional warrant as it had a condition that had to be fulfilled before it could be acted on. This condition was the arrival of Train 913 at Mataura. Part of the procedures when issuing track warrants were that the LE must read back a track warrant to train control. For conditional track warrants this was not required after a crew changeover. Indeed there was no rule or requirement for an LE to read his track warrant in such circumstances. Although no one thought it acceptable to proceed without reading an inherited track warrant, LE interviews showed LE 1's possible failure to read his warrant was not unique.
- A previously established pattern of crossings at Clinton. Clinton was the scheduled crossing place for Trains 938/919. Over the previous 5 months almost 70 percent of crossings had taken place at Clinton and LE 1 had crossed Train 919 there the previous day. Although there was no strong pattern associated with LE 1, the recency of his last crossing at Clinton, combined with low level fatigue induced by circadian rhythms tiredness, may have been sufficient to have established a perceptual set .
- Possible fatigue associated with the roster . Given that the accident occurred on the second shift after 2 full rostered days off, it is unlikely that he was unduly fatigued due to inadequate opportunity to rest or from excessive work. However, on both the day of the accident and the preceding day he had commenced at 0220

hours, which meant that his normal nightly sleep was disrupted. He did have adequate opportunity for daylight sleep on the day before the accident, but the early morning start and the effect of circadian rhythms on performance could have affected performance throughout the shift from handover to the time of the accident. The handover occurred within the 0300 to 0700 hours time frame. United States National Transportation Safety Board research has indicated that this is a time when there is an increased likelihood of error due to tiredness induced by the natural circadian rhythm of the body The contribution of fatigue and circadium rhythms effects to this accident, if any, are considered to be low compared to other factors.

Defences against perceptual set

The various audit reports and the comments of the LEs interviewed repeatedly drew attention to the fact that the TWC process relied totally on the diligence of the LE. This individual must correctly perceive the requirements of the warrant, retain that perception, maintain situational awareness and act exactly in accordance with the regulations and the warrant. If these conditions are met with 100% percent accuracy then there is no reason why TWC should not be as safe as any other traffic control system.

The reality, however, is that humans do not operate at 100% accuracy. Boredom, distraction, fatigue, illness, anxiety, misunderstanding and sensory problems can degrade performance. Operating inconsistencies can nevertheless be tolerated if there are appropriate defences in place to detect and correct the errors, slips or lapses.

With TWC a foreseeable error is the misperception of warrant limits. One possible form of misperception is the formation of an incorrect perceptual set. Perceptual set is the process by which a person becomes predisposed to perceptions which are consistent with prior experience. Once formed, a perceptual set is unlikely to be challenged by the holder.

One of the prime defences against this risk was the requirement for an LE to repeat the details of the warrant back to train control. While this process did not absolutely ensure that the LE would remember the limits or retain situational awareness it did reduce the probability of the formation of an incorrect perceptual set.

A second defence was the retention of the warrant within the cab. This was a passive defence and less effective than the active read back process. Once a perceptual set had been formed the LE was unlikely to re-check his track warrant, although he may well have read other clauses, such as checking to see if he had to make any radio calls to train control.

A third defence was a suggested "good habit" that LEs check their warrant at station warning boards This had been suggested on 2 occasions in a regular bulletin circulated to all LEs.

At the time of the accident, repeat back procedures did not apply when a warrant was taken by one LE and then handed over to another. There was no requirement for an LE handing a warrant over to another LE to ensure the relieving LE understood the contents of the warrant, nor did the regulations require the relieving LE to actually read the warrant. The argument could be made that the requirement to read the warrant was self evident and did not need to be mandated. However, given the fact that understanding the limits of a warrant is one of the most critical components of safe TWC operation, the absence of such a mandatory requirement introduced an opportunity for error

3 LE 1 on Train 938 did not establish the whereabouts of Train 919, or communicate with LE 2. The regulations required:

> When trains are required to cross, the Locomotive Engineer of the train which is required to berth on the loop must, before entering the loop, establish the whereabouts of the opposing train. If the opposing train is closely approaching the station he must communicate with the Locomotive Engineer of that train and come to a clear understanding of as to the berthing arrangements which will prevent both trains from entering the station at the same time. Should it not be possible to establish the whereabouts of the opposing train or to make contact with the Locomotive Engineer of that train then the train taking the loop may berth after establishing that the other train is not entering the main line.

Although an active failure, this was a direct consequence of LE 1's misconception as to his track warrant limit.

LE 2 was not required to call Train 938 before entering Waipahi. LE 1 did not contact Train 919 approaching Waipahi because he was not expecting a crossing. Had it been mandatory for both trains to communicate at crossings before either entered a crossing station the accident may have been avoided when related to the timing of events on the day. However, this would not have necessarily avoided a potential head on collision in the Waipahi/Clinton section if Train 938 had mistakenly passed through Waipahi on that day, before Train 919 was close enough to have initiated radio contact.

Latent failures

Recognition of human factors weaknesses associated with an operating system so heavily reliant on human input as TWC, and the provision of appropriate defences to combat these weaknesses, is a key to organisational requirement. Failure to provide adequate defences may be the result of latent organisational failures. The last 2 active failures associated with crew situational awareness and communication procedures come into this category.

TWC had a well documented history and had come under particular close scrutiny in the mid 1990's, mainly due to staff safety concerns.

This history included:

- A 1995 safety audit commissioned by the regulator, the Land Transport Safety Authority (LTSA) in response to particular staff concerns expressed to a member of Parliament This audit was carried out by United Kingdom based consultants and included amongst the terms of reference concerns raised by staff regarding the operation of TWC on the Main North Line. This audit included observations that the various rules and instructions could be consolidated and brought together, procedures for radio contact were unclear, the heavy dependence on human input called for more information on the behaviour in TWC situations and dictated that observance of rules was essential. The audit concluded that the system was not judged to be unsafe, but that there were inherent risks and areas of weakness that could and should be improved, and made recommendations regarding these. Two of these were:

    a) Discontinuation of the issue of track warrants before the arrival of the opposing train (conditional track warrants)

    b) Recovery and auditing of track warrants as a matter of course.

- In August 1996 the same consultants completed a post implementation review of the 1995 special safety audit. This noted that suggestions made with respect to the issue of track warrants had been partially adopted. The review repeated concern that conditional track warrants still remained in use. The auditors did consider the intent of the Kaikoura audit recommendations were being increasingly understood and acted on.

- In 1996 LTSA separately commissioned the consultants to carry out a risk assessment exercise of TWC throughout the Tranz Rail network which was also completed in August 1996. This study included reference to the following issues:

  a) a need to retain and audit track warrants

  b) the undesirability of conditional track warrants

  c) the dangers of LEs losing awareness of location

  d) the need for improved procedures regarding contact between trains at crossing stations.

  In particular the study included the following 2 recommendations:

  1) At crew changeovers, the arrangements in respect of train warrants should be amended to either·

     > Option A
     > Issue a warrant with a limit at the crew change over point so that the relieving LE must acquire a new warrant for the forward journey, or
     >
     > Option B
     > Require the relieving LE, before any movement takes place, to repeat to the control centre the authorities on the warrant being transferred and receive confirmation that he has done so correctly.
     >
     > Either of these options provides the stimulus to ensure that the fresh LE has been involved in the warrant authorising the movement of his train but Option A is preferred since the LE's involvement is absolute.
     >
     > ...

  2) Tranz Rail Limited should build on the requirement that on the approach to a warrant station where a crossing is to take place, the LE must establish contact on channel 1 of the radio with the LE of the train to be crossed. This should be done by requiring both LE's to endorse their warrants with the time confirming that this contact was in fact made This could then be audited

  When referring to these and other recommendations made in the study the authors described them as:

  > certain "low/no cost" actions are recommended as positive risk mitigation measures, aimed at ensuring the risks are kept "as low as reasonably practicable" (ALARP), by involving LEs.

The safety issue regarding arrangements for track warrants at crew changeovers was separately identified by the Transport Accident Investigation Commission when investigating an incident involving a track warrant overrun in 1996 (Report 96-101, Waipara, dated 23 October 1996). The incident occurred on 8

January 1996 when Train 701, the southbound *Coastal Pacific* passenger service, overran its track warrant limit and continued approximately 24 km into the next section before the error was realised. There was no opposing traffic or obstruction and once the overrun was discovered a valid track warrant was issued and Train 701 continued its journey. The causal factor was the LE's failure to recognise the limits of his authority to proceed. Safety issues identified were the long distances for which track warrants were issued and the need to reinforce track warrant requirements, particularly following crew changeovers

Safety recommendations made to Tranz Rail included that it introduce procedures governing the issue of track warrants to require an LE taking control of a train after a crew change to have to "accept" an open track warrant with the same "double check" procedures associated with the issue of new track warrants. This recommendation was very similar to that made to the LTSA by the authors of the 1996 safety study

Tranz Rail responded to the safety recommendation advising of action carried out which met the intent of the recommendation as related to long open track warrants, and advising they proposed a review of options to achieve the intent of the recommendation for crew changes involving track warrants with only short distances to be run

The LTSA made a copy of the 1996 risk study available to the operator, but took no action to enforce the 2 recommendations referred to. It believed it had insufficient justification to require adoption of the recommendations because:

- The legislation under which the LTSA was required to act required that before such recommendations could be enforced there had to be sufficient grounds for the Director to believe that a person was likely to be placed at significant risk of death or serious injury if the recommendation was not implemented
- it considered it had no evidence, given that no serious injuries or death had occurred in TWC operations, to meet the legislation test of "placed, or could have placed, a person at risk of serious injury or death", and that cost benefit analysis could therefore not be justified
- it considered other priority areas took precedence in the LTSA/Tranz Rail interface, and quoted shunting and track buckling as 2 such areas.

Before deciding it had insufficient justification to enforce the recommendations no cost benefit analysis was carried out by the LTSA, or sought from the operator, to test the criteria of safety at reasonable cost.

5. Safety at reasonable cost in the New Zealand transport scene

The concept of safety at reasonable cost is the underlying principle of safety in all modes of transport in New Zealand, and safety at reasonable cost has been defined.

Some significant references to safety at reasonable cost in New Zealand's regulations framework are:

- The Ministry of Transport mission:

> "We work for safe sustainable transport at reasonable cost..
> At reasonable cost
> means where the benefits to New Zealand exceed the costs to New Zealand "

- The Land Transport Act 1998 – Part 12

> 169. Functions of Minister – (1) The Minister's principal function under this Act is to promote land transport safety at a reasonable cost.
> (4) For the purposes for this section, a cost is a reasonable cost if the value of the cost to the nation is exceeded by the value of the resulting benefit to the nation..

- Civil Aviation Act 1990 – Part II

> 14. Functions of Minister – (1) The principal functions of the Minister under this Act shall be to promote safety in civil aviation at a reasonable cost
> (3) For the purposes of subsection (1) of this section, a cost is a reasonable cost where the value of the cost to the nation is exceeded by the value of the resulting benefit to the nation . . .

annotated in Brooker's Aviation Law by:

> . . . CV14.04 For the first time in legislation of this kind parliament has made reference to cost benefit analysis. There is an acknowledgement by the Legislature that there is no such thing as absolute safety. The standard set by subs (3), whereby the cost to the nation is weighed against the benefit to the nation, requires the sort of calculation with which economists will be familiar. This requires the making of assumptions as to the variables involved, such as the monetary value that can be assigned to each life saved balanced against the cost.

- In particular regard to rail service operations the Transport Services Licensing Act 6 c (1):

> 6c. Matters to be taken into account in considering proposed safety system – (1) In considering a proposed safety system, the [Director] shall have regard to, and give such weight as he or she considers appropriate to, the following matters:
>
> (a) The nature of the proposed rail service operation
>
> (b) The safety system attainable, consistent with the nature of the service, at a reasonable cost:
>
> (c) The relationship between the proposed safety system and comparable safety systems applicable to competing modes of transport·
>
> (d) The past history and performance (if any) of the applicant within the transport industry:
>
> (e) Any submissions or representations received from the operator of any railway that the applicant intends to use.

6. The Operator

The operator did not action the recommendations as intended. It believed Option B of the first recommendation regarding crew changeovers had been effectively achieved by recommendations/suggestions circulated to staff in an informal Locomotive Engineers Bulletin. Such suggestions can be a useful means of reinforcing a rule or procedure but are not necessarily an effective substitute for a clearly defined rule or procedure requiring that, regardless of how the warrant was received, there was a mandatory read back and verification process No cost benefit analysis was carried out when considering the recommendation. Costs of implementation were assessed during consideration but the operator stated safety at reasonable cost was not the basis for the actions taken.

The second recommendation regarding radio procedures was not implemented by the operator because it was thought to be "extremely impractical" This related to the operator's perception that to audit the system, all track warrants had to be kept for a long period. Again the operator advised that safety at reasonable cost was not a criteria and no cost benefit analysis was carried out.

As a result no changes were made that either·

- built on the requirement that on the approach to a warrant station where a crossing is to take place, the LE must establish contact on channel 1 of the radio with the LE of the train to be crossed
- required both LEs to endorse their track warrants confirming contact had been made
- audited such endorsements.

The end result of Tranz Rail's response to the various reports and recommendations since 1995 which related directly to events preceding the Waipahi accident was that an opportunity to implement defined defences to particular recognised hazards, and thus reduce risk at "low/no cost", was lost.

7. The Regulator

A key function of the LTSA within the legislative framework was to represent the interests of the travelling public and staff by ensuring that the transport service was as safe as could be achieved given the costs. The LTSA approved the safety system and monitored compliance with that safety system through a series of regular and special audit checks. The position of the LTSA was that they did not impose solutions except "where LTSA had reasonable grounds to believe that a person was likely to be put at significant risk of death or serious injury unless satisfactory action were taken in mitigation of the perceived hazard". This philosophy was based on the observation that imposing solutions transferred ownership of those solutions from the operator to the regulator which can create a climate in which an operator adopts the position of proving that a particular solution proposed is impractical, and in doing so fails to address the root problem.

Despite the recommendations made to the LTSA, an opportunity to provide 2 "low/no cost" defences which may have avoided this accident was not realised during the subsequent regulator/operator interface.

It is not in the best interests of transport safety if potential "low/no cost actions" arising from a safety authority study are not tested against the criteria of safety at reasonable cost before it is accepted that variable or no action is appropriate. A mechanism and intent is needed within the regulatory regime to achieve this. Both the operator and the regulator have a role to play in this process.

The LTSA has recently sought a change in legislation which it sees as necessary to ensure it can act in similar situations in the future.

8. Safety culture

Tranz Rail placed a high value on safety. In its 1999 Annual Report Tranz Rail stated, "The safety of our employees and the integrity of the network is one of our top priorities". There is no reason to doubt the genuineness and sincerity of Tranz Rail's belief in the importance of safety. However the investigation showed gaps in the effectiveness of commitment, particularly as shown by the different perceptions of senior mangers, field managers, and the front line staff as to what was happening at the operational level

These differences were apparent in such matters as supervision practices, compliance monitoring, local variations to procedures and the levels of risk. Senior managers stated, for example, that staff were free to raise concerns whereas staff interviewed said they had serious reservations about doing so. Where the LEs expressed concerns about the risks in the job, the senior managers cited a comparative risk study as evidence that the risks were no greater than other parts of the network It could be argued that senior managers did not necessarily need to know all aspects of day to day practices, but the specific recommendations made in 1995 and 1996 related to just such day to day practices However, they were dealt with at senior manager level with no evidence of referral to, or input from front line operating staff

Tranz Rail's reactive as opposed to proactive response to suggestions related to the suitability of the TWC system did not create a climate to maximise the benefits arising from the external rail expertise involved

9. Conclusion

It would be easy to put this accident down to "human error", indeed the principal conclusion of the internal investigation was that LE 1 failed to read his warrant when he assumed control of Train 938. The underlying reasons for why such errors are made are the key to effective safety investigation to avoid similar accidents in the future.

In this case the "why" has highlighted the following issues:

- The particular importance of the rules and regulations governing a low technology, high human reliance, rail operating system, and the need for procedural consistency in applying such rules. A quote from a paper "Some things never change" presented by Frank Turner at Banff last year is relevant.

  > However, one fundamental that has not changed is the understanding and application of safety and operating rules. While we have greatly improved on the amount and type of training we offer to employees and officers, the fact remains that to have a safety, injury free, railroad operation officers and employees must understand and comply with all safety and operating rules.
  >
  > This safety and operating rule "knowledge" has to begin at the top The operating officers have to be consistent in their understanding of the rules They have to set an outstanding example in their compliance with the rules. This safety and operating rule knowledge has to continue through the rank and file. No rule can be compromised.

- The need for defences to guard against perceptual set caused by changes to established patterns.
- The need for a proactive response to suggested safety improvements rather then a reactive defensive desire to protect the status quo
- The need for a regulator/operator interface that ensures recognised safety enhancements that meet the criteria of safety at reasonable cost are introduced

I believe that the issues are not unique to rail transport in New Zealand.

International Rail Safety Conference

2000 LONDON

8 November - 10 November 2000
Forum Hotel, London, United Kingdom

Paper 0028

Bob Smallwood

SPAD Reduction: Human and Infrastructure Factors

Publisher
2000 International Rail Safety Conference

International Rail Safety Conference

Bob Smallwood

HM Deputy Chief Inspector of Railways

HSE, UK

SPAD Reduction - Human & Infrastructure Factors

INTERNATIONAL RAILWAY SAFETY CONFERENCE
Day 3 (10 Nov)
0930 - 1000

SPAD Reduction - Human and Infrastructure Factors

Introduction

Ever since signals were introduced in the very earliest days of railways, SPADs have been a problem, and there have been many serious accidents caused by SPADs over the years; the worst being at Harrow and Wealdstone in 1952 when 112 people were killed. The most recent serious accident was at Ladbroke Grove in October 1999, and this has generated an unprecedented level of public concern about railway safety.

During this presentation I will briefly cover the situation in the UK and the HMRI's SPAD related work by prior to October 1999, followed by the changes that were made shortly after the Ladbroke Grove accident. I will then update you on the current situation and the changes that have occurred over the year before finally giving a summary of the actions that are being taken both by HMRI and the industry.

SPADs in the UK

Firstly, I need to define what is meant, in the UK, by a Category 'A' SPAD - it is the term used to describe an incident when a train has passed a "Signal at Danger", without authority, where the stop aspect or indication was displayed correctly and in sufficient time for the train to be stopped at the signal. It also includes the unauthorised passing of other types of stop signal (i.e. signals used for shunting movements or to denote the limits of a line blocked for maintenance work).

When a train passes a signal at Danger it is usually immediately apparent to the Railtrack signaller via the track circuit indications in the signal box. The signaller is then required to report the matter to Railtrack's control centre who will initiate an investigation into the incident in conjunction with the train operator concerned. This is in accordance with the procedures laid down in the Railway Group Standard on Signals Passed at Danger. In addition, since 1995, when the new Reporting of Injuries, Diseases and Dangerous Occurrences Regulations 1995 (RIDDOR 95) came into force, these required, for the first time, statutory monthly reporting of Category A SPADs.

It can be said that many SPADs have little or no potential to cause harm, since they result from minor misjudgments of distance or braking capability, or they occur at low speed during shunting operations. Also in most cases the potential consequences in practice are zero or are limited because the trains involved usually stop within the "overlap" to the signal. That is the safety margin specifically provided for additional protection which generally extends 200 yards beyond the signal, although it may be shorter in lower speed areas.

The History

In the UK only 2.7% of all collisions and derailments over the last 30 years have been SPAD-related. However, the outcomes can be extremely severe as we saw at Southall and Ladbroke Grove. SPADs are still the largest single cause of train collisions and/or derailments that result in passenger fatalities. On British Rail (BR) and subsequently on Railtrack there have been several hundred SPADs each year for as long as records exist. Throughout the latter half of the 1980s the number of SPADs recorded grew yearly until they peaked at 944 for all types of SPADs on the then BR network during 1991/92. Since then, BR and subsequently Railtrack and the train operators - operators of passenger and freight trains and on-track machines - implemented a series of initiatives aimed at reducing the number of SPADs. Similarly, HMRI has in the past, and continues to give SPADs a high priority within its own work programmes.

The various initiatives led to a general downward trend. However in 1997/98, HMRI considered that the overall level of SPADs was still too high and that industry could do more to control the risk. As a consequence HMRI conducted a year long special inspection into the way the railway industry manages the risk of trains passing signals at Danger. HMRI published its report containing 22 actions on 2 September 1999[1]. The audit examined:

- how SPAD incidents are investigated and reported;
- the systems used to identify corrective action; and
- the effectiveness of action taken to stop repeat SPADs at the same signal.

The report recognised that the industry had undertaken a lot of good work to reduce SPADs, but identified significant weaknesses in industry management systems and in how effectively they are followed. In particular the report highlighted two key areas where real improvement was required. These were the need to carry out investigations promptly and find the root cause of the SPADs, and to find more effective methods of reducing the number of multiple SPADs i.e. those signals which have a history of more than one SPAD. HMRI also concluded that more improvements were required in the following key areas:

- revising and improving internal procedures and ensuring that these are followed;
- closer liaison between Railtrack and the train operators in evaluating and disseminating lessons learnt from internal investigations; and
- prioritisation of resources to reduce the backlog of internal investigations.

It was found that the situation varied across the country, but in general there seemed to be more emphasis on completing the multi-page SPAD investigation form than getting to the root cause of the SPAD incident. Investigations were taking a considerable amount of time and where Signal Sighting Committees were needed, these were taking far too long to convene. Following this, the implementation of recommendations was also taking far too long.

---

1 [1]"Report on the inspection carried out by HM Railway Inspectorate during 1998/99 of the management systems in the railway industry covering signals passed at danger." Copies are available on the Internet at http://www.open.gov.uk/hse/railway/spad-01.htm

With regard to signals that had been passed at danger a number of times (Multiple-SPAD signals), HMRI found that these were not dealt with in a structured way based on any sort of risk assessment. This was of concern as HMRI believed that if a signal had been passed at danger more than a couple of times then there was a much higher chance of it being passed at danger again. It also inferred that there may well be infrastructure problems as well driver behaviour issues.

The Ladbroke Grove accident

As you are aware, shortly after publication of the SPAD investigation report the accident at Ladbroke Grove occurred on 5 October at signal SN109. This led to HMRI reviewing its own SPAD related work and the creation of a whole raft of new workstreams.

One immediate change was that HMRI required that Railtrack reports all SPADs incidents on a daily and monthly basis going significantly beyond legal requirements in RIDDOR. This means that SPADs are now being monitored much more closely and HMRI reviews the adequacy of all Railtrack's SPAD investigations to see if the root cause has been found and appropriate action is being taken. HMRI also carries out its own investigations of the most serious incidents - that is those with the potential to cause serious harm as well as those which have resulted in actual harm - in addition to the required industry investigation. In addition, Ministers are given weekly statistical updates of the SPAD incidents which occurred during the previous week and detailed monthly reports of the SPAD incidents and HMRI's investigations, which are also published on the internet.

HMRI also now categorises SPADs into three severity levels. For the least serious (c200 a year) HMRI will review industry's own investigations. For the medium category (c250 a year), HMRI will in addition visit the relevant train operating company and Railtrack zone to interview those who have conducted the industry investigation. The aim is to ensure that root cause has been correctly established and appropriate remedial action taken. For the most serious SPADs (c150 a year) that is those which result in actual harm or have the potential to cause serious harm, HMRI will conduct its own investigation in addition to that undertaken by the industry.

Another consequence was the serving of three enforcement notices on Railtrack, which have prompted considerable industry action:

- a prohibition notice, currently subject to appeal by Railtrack in the High Court, prevented trains being routed through signal SN109, the signal at the heart of the Ladbroke Grove disaster. The notice reduced capacity at Paddington station and Railtrack is still working on a revised track and signalling layout for the Paddington approaches;

- an improvement notice covering the top 22 multiple-SPAD signals (including signal SN 109) has also reached the High Court on appeal, again at Railtrack's behest. The notice is therefore suspended and with it the remedial programme which HMRI had identified as necessary. Railtrack's public stance is that it is doing everything to comply with the requirements of the notice despite appealing against it.

- a second improvement notice covered 190 signals with more than one SPAD within the last 5 years. Railtrack also appealed against this notice but, unlike the previous two, succeeded in getting it quashed. Nevertheless, HSE, assisted by WS Atkins, are assessing the adequacy of Railtrack's proposed remedial measures at all remaining multiple-SPAD signals.

In addition to the attention on infrastructure issues, there has been many other initiatives related to train driving standards eg:

w HMRI commissioned the development, by the Rail Industry Training Council, of a new, "top-up" training package on defensive driving.

w The Association of Train Operating Companies developed new codes of practice on driver recruitment and selection, training and assessment, competence and fitness, and transfer of driver records between companies. Which, in due course, Railtrack will incorporate into their mandatory Railway Group Standards.

w In July, Railtrack published a study identifying which of the many initiatives industry is implementing to reduce SPADs is considered most effective by drivers - the results were the "top-up" training, plus a greater emphasis by line management on safety.

w Railtrack is extending the Confidential Incident Reporting and Analysis System (CIRAS) to receive, confidentially, reports from railway employees of incidents which would otherwise go unreported, giving companies the ability to take action to reduce the likelihood of accidents occurring. This will soon be a national system.

HSE has published (in October 2000) a new addition to its Railway Safety Principles and Guidance on developing and maintaining staff competence, and through its normal inspection work HMRI is seeking improvements in the standards for training of those who manage and brief drivers. In particular to ensure that train operators are:

v using the ATOC Codes of Practice on driver training and management them as part of their driver training and management procedures.

v undertaking route risk assessments of hazards such as multiple-SPAD signals and other situations and are implementing procedures and controls to address them.

v incorporating into the driver training and development programme the risk reduction measures identified from the risk assessments.

v communicating key safety information to train drivers, assessors and their managers as part of the driver training process and subsequently through briefing;

v maintaining, monitoring and improving current standards for driver assessors and driver managers;

v implementing procedures for providing post qualification supervision, assessment and monitoring of newly qualified drivers and of drivers recruited or transferred from other train operators;

v ensuring that the driver training programme for new entrant and newly qualified drivers is verified, audited, evaluated and reviewed

HMRI's 1997/98 special inspection did not cover driver competence and fitness issues and these are now being reviewed as part of a three-year inspection programme of the 36 train operating companies. As well as ensuring the above, programme will cover driver management competence, competence of trainers, driver training, driver competence assessment, driver suitability profiling, root and knowledge testing, miscommunication issues and timetable change effects.

SPAD Analysis

Since Ladbroke Grove there have been many reports on SPADs and often attempts have been made to form conclusions based on month by month analysis, or by comparing train operators. Invariably it is not possible to draw from conclusions based on such short terms results, or by comparing train operators operating different mixes of train type and service. Firm conclusions can only be drawn when looking at longer term results, overall trends, and normalised data.

Prior to the Ladbroke Grove accident there was a general reduction in the number of SPADs. This has continued and since July 1999, there has been an overall downward trend in the number of SPADs. Also, since November 1999, with the exception of figures for March and June the monthly totals have been the lowest ever recorded for that month since 1985. Even for March and June the figures are the third and second lowest respectively.

While this is indicative of an overall improvement, there is still a wide monthly variation, suggesting that special causes may occasionally dominate. It is therefore too early to determine statistically whether the common causes represent continuous improvement. However, the trend gives some optimism that the emphasis placed on SPADs since early 1999 is helping reduce their occurrence. It could also be indicative that the defensive driving initiatives are having a positive effect as the reduction is predominately due to fewer severity category 1 and 2 SPADs.[2] If this is true, then the effectiveness of Railtrack's modifications to the infrastructure in reducing SPADs will also take longer to observe. Firstly, changes to individual signals are not done en-masse and work is still in progress and secondly, the effect of the changes will only be seen by an absence of SPADs over a prolonged period of time.

Severity category 3 to 8 SPADs are considered serious and are monitored as a group in their own right. Analysis of this category since April 1999, shows that despite a wide monthly variation in the number of serious SPADs, the rate of occurrence has remained essentially constant. This implies that serious SPADs might be due to causes that are not being remedied by the current defensive driving initiatives. It is also consistent with the fact that, more often, serious SPADs, especially those at multiple-SPAD signals, have infrastructure factors and are caused by the driver 'misreading' or 'failing to react' to the caution signal. All of which emphasises the need for more "in-depth" investigations into severity 3 – 8 SPADs to identify the root causes of the incidents. Both Railtrack and

---

2[2] **Railtrack's SPAD Severity category decode -**

1 Overrun 0 to 25 yards, overrun not exceeding overlap, and no damage, injuries or deaths
2 Overrun 26 to 200 yards, overrun not exceeding overlap, and no damage, injuries or deaths
3 Overrun greater than overlap plus all overruns greater than 200 yards and no damage, injuries or deaths
4 Track damage only with no casualties.
5 Derailment with no collision and no casualties
6 Collision (with or without derailment) and no casualties.
7 Injuries to staff or passengers with no fatalities
8 Fatalities to staff or passengers

HMRI are currently working to gain a greater understanding of the features that can lead to serious SPADs.

Multiple SPADs

There are approximately 30000 signals across Railtrack's controlled infrastructure that are capable of displaying a stop aspect. On average, over the last 6 years, an average 680 have been passed at danger each year (596 in 1999/00). Again on average over the last 6 years 62% of these SPADs occurred at signals that had not previously been SPADed. Therefore the most effective way of reducing the total number of SPADs would be to ensure that trains stop at signals when required to do so. But initiatives, such as the Train Protection & Warning System (TPWS), that are being put in place will take time to be effective.

The cause of a SPAD can be categorised as one or more of the following: driver error; infrastructure factors; train performance problems (e.g. brake problems, perhaps caused by low adhesion); or communication misunderstandings between the driver and the signaller. The propensity for a signal to become a multiple-SPAD signal is also related to the number of times the signal is approached at Danger. The historical data suggests that for a signal with more than two SPAD incidents, infrastructure factors are probably the more dominant cause (e.g. gradients, curves, gantry mounted signals, station stops before the next signal at Danger (causing the driver to forget the early warning indication of what the next signal is showing)).

As said above, the propensity for signals to have SPADs is not constant across all signals, since apart from any inherent variability in the signals themselves, any variation in traffic flow past the signal will affect the SPAD rate. There will also always be a random element where some signals will suffer 2 SPADs within a 5 year period (Railtrack's definition of a mutli-SPAD signal). However, the total number of signals being passed at danger twice or more is greater than would be explained by this random element. If signals are passed at danger more than twice, this random element becomes even smaller and by the time a signal has been passed at danger four or more times the random element is effectively zero. Currently there are 80 signals which have been passed at danger 4 or more times within the last 5 years.

Consequently, a more immediate improvement in the overall SPAD rate should be possible by prioritising action on multiple-SPAD signals, but without losing sight of other actions which should reduce SPADs generally. Both HMRI's and Railtrack's work prioritsation take this into account.

Currently in the UK Multiple-SPAD signals are being dealt with in several ways:

- One of the actions of HMRI September 1999 SPAD report required Railtrack and train operating companies to collaboratively risk assess all multiple-SPAD signals, and together, develop adequate control measures to be implemented on a time-bound basis to reduce the risk of further SPAD incidents occurring.
- If the previous SPAD incident occurred within 5 years of the current incident, the signal is put on Railtrack's multiple-SPAD signal list which is sent out to all train operators for use in briefing drivers. In addition, if the signal has been passed at Danger

within the previous 12 months, or there is a request by the train operator concerned, a signal sighting committee will be convened to examine the signalling infrastructure.

- Railtrack has drawn up what is known as an 'Anti-SPAD Toolkit' of measures that can be implemented at multiple-SPAD signals. This provides a good basis for action to be taken at multiple-SPAD signals, but must be used consistently throughout the network.

- In January, Railtrack started an ongoing project to identify 'bad actor' incidents, defined as SPAD incidents where the signal involved had 5 or more previous SPADs, or the driver more than 2. The purpose is to try and identify common issues on the cause of SPADs, and identify the factors which has led to a general reduction in the number of SPADs since October. If these can be identified, then emphasis can be put on the most effective measures.

- Railtrack have commissioned work to analysis the human factor aspects of driver' perceptions, driver's visual and mental awareness, and driving cab environment.

- Railtrack have produced a CD-rom showing photographic views of the approaches to all multiple-SPAD signals which occurred during the last 5 years.

The current work and the future

HMRI's long term strategy is to ensure that the railway industry itself is doing everything it reasonably can to eliminate and mitigate risk from SPADs by:

- reducing the number of SPADs so far as is reasonably practicable by driving the industry to create, review and implement a global SPAD strategy;

- eliminating or reducing, so far as is reasonably practicable, all causations underpinning SPADs, targeting them in the order which will get the greatest health and safety benefit most quickly; and

- seek to restore confidence in the railway industry's ability to manage SPADs risks properly, without the current high levels of intervention from RI.

It must be said that SPADS can only be eliminated by hardware controls (eg. Automatic Train Protection (ATP)) hence the drive towards improvement of train protection systems is vital. In the meantime HMRI intends:

- To ensure that all SPADs are properly investigated by the industry within the timescales identified in the Railway Group Standard, the root causes of the incident identified, the lessons learned and, where necessary, information disseminated widely and action taken to eliminate the cause.

- To continue producing monthly reports as a means of disseminating information to the industry, keeping the public informed, and keeping pressure on the industry through publicity to reduce the number of SPADs. (Railtrack also produce a detailed monthly report on SPADs and have recently started making these available through the internet)

- To ensure that the risks at multiple-SPAD signals are reduced so far as is reasonably practicable. Consultants have been working with HMRI to examine the multiple-SPAD signals to identify common issues and this information is now being used to help inspectors identify reasonably practicable SPAD reduction measures during routine inspection and incident investigation work.

w To ensure that Railtrack routinely and consistently apply lessons learned from good root cause analysis to signals right across its network (whether multi-spaded or not).

w To review the adequacy of Railtrack's and ATOC's new standards that might have an impact on SPAD issues.

w To identify the specific SPAD risks that will not be covered by TPWS and develop a plan of work for these areas, such as poor adhesion and miscommunication between drivers and signallers.

w To assess the adequacy of management systems in TOCs for managing drivers so as to ensure the number and severity of SPADs caused by driver error is reduced so far as is reasonably practicable. This is the three-year inspection programme previously mentioned.

w To use the experience and knowledge gained from Ladbroke Grove (and other work) to identify lessons relevant to the layout at other major stations and junction networks and that are not already covered by the multiple-SPAD work.

w To ensure that HMRI has an efficient information and intelligence gathering system for work being done or planned in industry.

w To ensure effective exchange of information and lessons learned on SPADs by designers, manufacturers, operators, maintainers – with the overall aim of increased confidence in the quality and sustainability of industry's systems for reducing SPAD numbers. This will look at initial integrity issues and the success with which human factors, ergonomic as well as engineering issues are tackled. – to ensure that dutyholders manage SPADs properly in terms of the arrangements set out in their safety cases.

w To identify and learn from the best international regulatory experience through involvement with the International Liaison Group of Government Rail Inspectors (ILLGRI).

w To monitor industry's work and methods for taking account of human factor issues and improving safety culture. As part of this work a new Railway industry Advisory Committee sub-group has been formed on human factors and to pursue relevant research opportunities.

The above gives an indication of HSE's work in SPAD reduction. In addition the industry is taking a number of other different initiatives to reduce the number of serious SPADs These include:

w Improving the quality of SPAD investigations to clearly identify and understand the underlying causes of the incidents and use this information to help prevent future incidents from the same causes.

w Improving their understanding of human factors issues to better understand the factors that contribute to drivers having SPAD incidents (for example, roster patterns, shift patterns, cab environment, competence etc.).

w Improving driver training by complying with new codes of practice covering selection and training of new drivers, and the arrangements for specially monitoring drivers (these are drivers who have had SPAD incidents). This is through use of the new Codes that have been developed by the Association of Train Operating Companies, and by use of cab driving simulators.

w Improving communications between signallers to drivers to reduce misunderstandings by drivers, when stopped at a signal at Danger. This work is at an early stage and there is still much the industry has to do to ensure robust communication protocols.

w Ensuring defensive driving techniques are complied with eg all operators have defensive driving policies which require drivers to reduce speed to 15 or 20 mph 200 yards before any signal at Danger.

w Ensuring drivers use the Drivers Reminder Appliance (DRA), which is a device and warning light that is operated automatically on some trains or manually by drivers on others and is used to reduce the risk of start away SPAD incidents by isolating traction power when stopped at a signal ahead displaying a red aspect.

w Unobtrusively monitoring driver performance by increasing the numbers of on-train monitoring recorders. These will aid monitoring of defensive driving techniques as well as compliance with speed restrictions etc.

w Fitting of sanders to trains fitted with disc brakes which are more prone to wheelslide during periods of low adhesion.

w Introduction of new competency standards for signal sighting committees to ensure use of a risk based approach which will include consideration of the possible consequences of passing the signals at Danger and identifying the human factors which contributed to the SPAD incidents.

w Fitting of Train Protection and Warning System (TPWS) which provides safe braking within the overlap zone for trains not exceeding 75mph and is now being fitted throughout the network. There is a legal requirement to complete fitment by 2003.

w Implementation of the recommendations from HMRI's 22 SPAD actions on SPADs.

w Identification of common causes of Multiple-SPAD signals and improved briefing to drivers about multiple-SPAD signals, making use of colour photographs and video to reinforce the message.

Summary

I hope that I have shown there is extensive work being undertaken both by HMRI and the industry, but this is an area where work can never stop. In particular SPAD reduction is not only about improving defensive driving standards and then monitoring compliance, but also about understanding and improving the infrastructure related factors that lead to SPADs.

In addition, there is a fundamental need to fully understand all the human factor issues, some of which are cross-industry, and to tie these together to create co-ordinated work programmes.

We also need to be more self challenging and regularly ensure that we are taking the most appropriate action in the most effective way.

International Rail Safety Conference

2000 LONDON

8 November - 10 November 2000
Forum Hotel, London, United Kingdom

Paper 0029

Dave Billmore

GNER Experience of Confidential Incident Reporting by Staff

Publisher
2000 International Rail Safety Conference

International Rail Safety Conference

Dave Billmore

Safety & Loss Control Manager

GNER, UK

GNER Experience of Confidential Incident Reporting by Staff

GNER and CIRAS
D.J.S.Billmore, Safety and Loss Control Manager, GNER.

GNER's involvement with CIRAS began with a presentation by Scotrail at the Railtrack Scotland Loss Control group in Jan 1997 which described their early experience of the system.

Coincidentally an article appeared in the Times which discussed various confidential reporting systems including CIRAS. This caught the eye of our Chairman David Benson who passed it to me with a request to follow up and report back.

Discussions with Strathclyde University followed.

Benefits were seen as :-

1. To gain qualitative insight into how small failures or errors develop into near misses and/or actual accidents; improve the completeness of accident and incident reports (this is especially true of CIRAS which follows the majority of reports up with a taped interview).

2. To gather statistical data regarding the occurrence of factors or the combinations of factors which give rise to incidents; increase the information available to build up a human error database.

3. To maintain a level of alertness to danger, especially when the accident rate is low. Help overcome the barriers associated with near miss reporting (CIRAS is a blame-free, confidential third party reporting system). Increase suggestions for improvements

There are a number of benefits to be gained from the purposes listed above. Having gained a qualitative insight into the events leading to a near miss (which may be considered as precursors to actual future accidents) an organisation can take remedial action to reduce the likelihood of such an occurrence i.e. the error inducing factors can be eliminated or their impact weakened. Where human recovery has prevented an accident by timely corrective action this can be strengthened.

Cost /Benefit comparison.

Comparison with the costs of typical incidents indicated that the potential benefits of implementing CIRAS outweighed the costs of operating the system by a significant margin.

The Board of GNER approved the necessary expenditure and implementation began in late 1997, with much assistance and advice from Strathclyde and Scotrail.

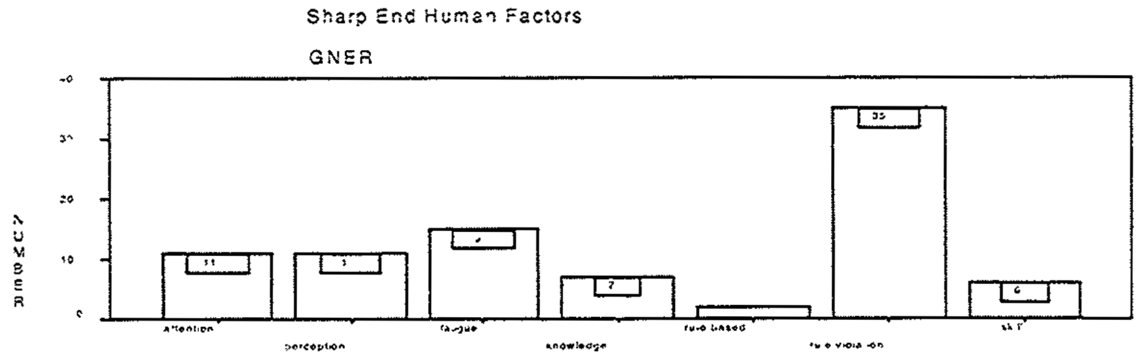
It took 4 months to train briefers, brief in the scheme and begin to get reports back from staff.
A variety of media were used to get the message about CIRAS across: letters to individual employees, team briefing, articles in the company newspaper and posters. Throughout close liaison has been maintained with HMRI and Trades Unions who have supported the scheme from its earliest days.

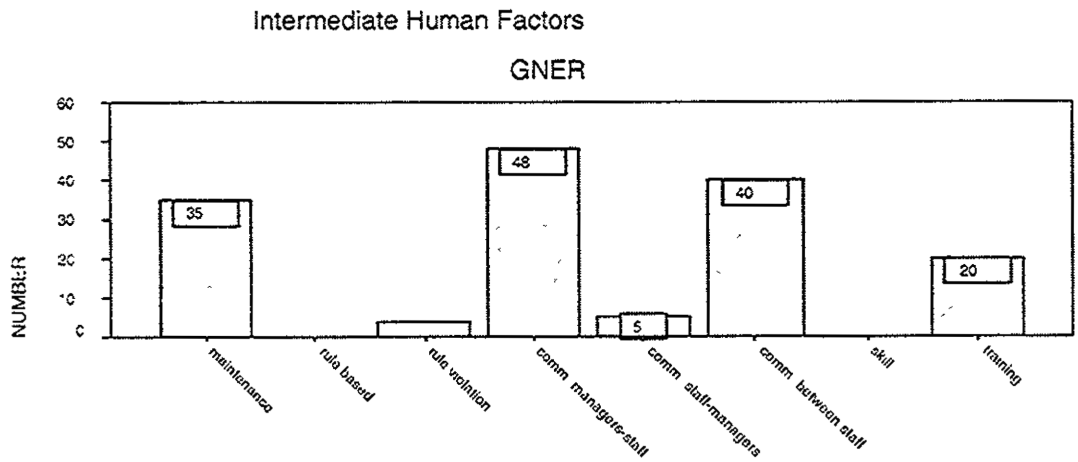
Staff trust the confidential aspect of the system. From the companies viewpoint it has pinpointed some potentially serious issues and the challenge to GNER is to continue to address these quickly and effectively. The faith of the staff in the system will increase if they see concrete results from their reporting.

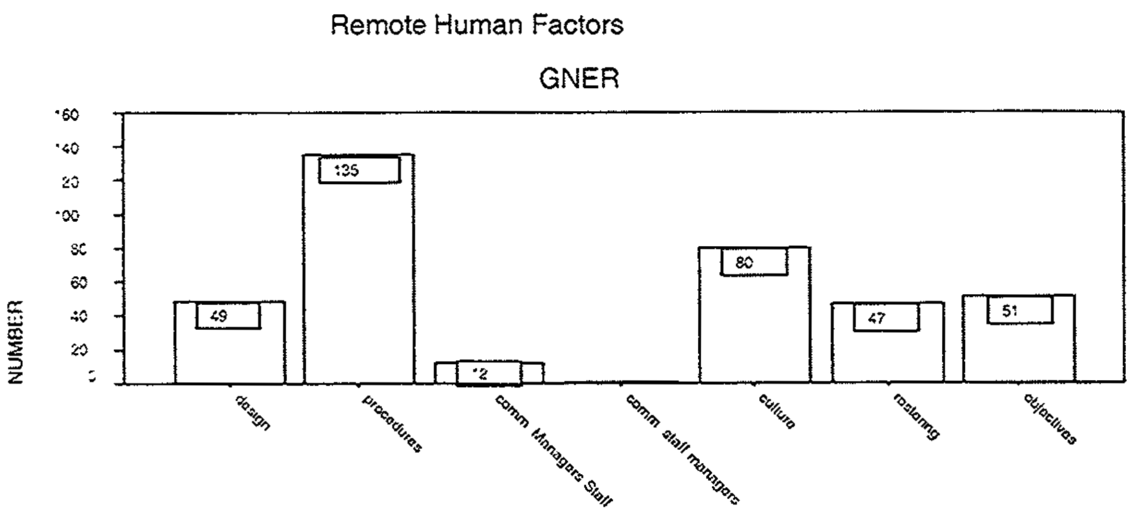
As the database grows CIRAS has the potential to become a major tool in reducing the historically intractable incidents which are attributed to "human error" by increasing understanding of the precursors to incidents , and allowing remedial action before an accident occurs.

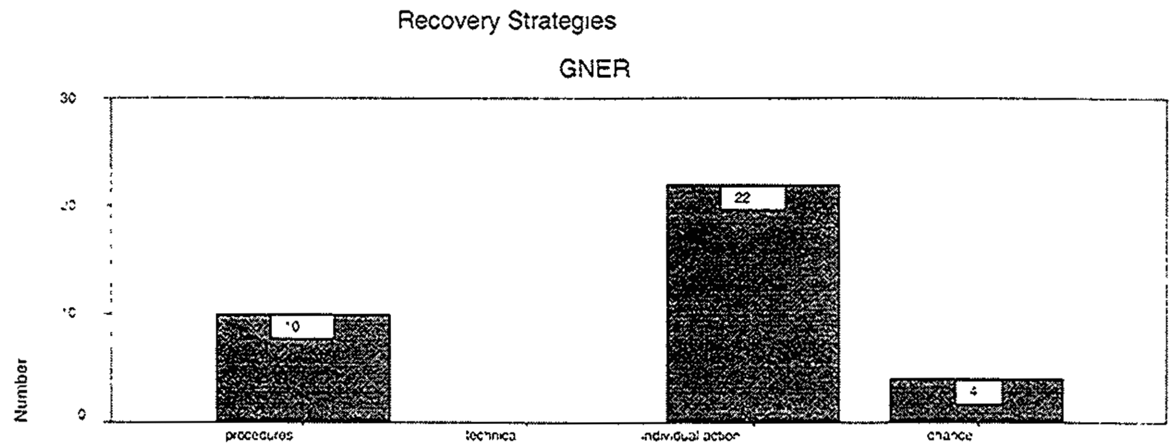
Abstract from an analysis performed by Strathclyde on the reports recorded in the CIRAS Database.

Shown here simply as an illustration of the kind of reports that can be obtained. Clearly the results will guide prioritisation of action.









The abstract above was only part of a large analysis, comparing various companies and the following conclusion was reached.

"Conclusion

The most important conclusion in terms of the initial inquiry is that the distribution of root and immediate causes in GNER is not significantly different from the other TOCs or from all the companies considered as a whole. This indicates that, within the scope of this basic enquiry, there are no specific safety issues unique to GNER."

DAVID BILLMORE

GNER

Background

- GNER aware of BYRD triangle
- Expecting far more near misses
- very few reports

  - Own near miss system little used

  Conclusion :

  - not trusted

Goal and Objective

- To flush out the missing information
- Understand where we are vulnerable
- Use the information to reduce incidents

CIRAS Process

- **Member of staff decides to report something**
- **Phones or writes to CIRAS at Strathclyde University**
- **Confidential interview**
- **Researchers code responses and enter anonymously into database**
- **Database available for interrogation**

Today's Situation(1)

- **GNER 33 months into the process at Sept 2000**
  - **- all Safety Critical Work Staff enrolled**
- **Reports at 21/9/00:**
  - **- 35 Maintenance**
  - **- 51 Driver**
  - **- 46 On-Train**
  - **- 26 other**

Today's Situation(2)

- **Of these reports 139 have been coded by Strathclyde University**
- **Raising 96 issues**
- **of which 41 refer to incidents**

How Did We Get Here? (1)

- **Roll the turf**
  - **- High Level buy-in**
  - **- Early information to Trades Unions**
  - **- HMRI Support**
  - **- Letter to all Safety Reps**
  - **- Letter to all SCW staff**

How Did We Get Here? (2)

- **Train the briefers**
  - **- Strathclyde**
  - **- Senior TOC support at briefings**
- **Provide Good briefing pack**
- **Posters**
- **Follow up letter to all SCW staff**

GNER

Problems (1)

- **Lack of Trust**

  - stress confidentiality / explain system

  - invite representatives to Strathclyde

- **Location of reporting forms**
- **Use of CIRAS for "political" ends**
- **Use of CIRAS instead of proper reporting systems**
- **Unimportant issues**

Problems(2)

- Liaison Committee-correct management representation
- Need for a clear process
  - to receive information from CIRAS
  - to disseminate information to committee members
  - to track progress of issues
- SCW staff list for journal distribution

Costs/Benefits (1)

- **Cost £15.25/head/year+core costs**
- **Includes all Strathclyde input, Journal and distribution etc.**
- **Excludes own company management time**
- **Excludes free passes for researchers**

Costs/Benefits (2)

- **One fatality** **£1,000,000 minimum**
- **Major buffer end collision, including Station damage** **£3,000,000**
- **Single act of vandalism** **£25,000**
- **Level Crossing incident** **£70,000**
- **Minor rear end collision** **£150,000**

Costs/Benefits (3)

- **CIRAS has uncovered a situation not suspected which would eventually have led to a fatality**
- **Now corrected-and monitored**
- **Avoidance pays CIRAS fees for years**

GNER

Costs/Benefits (4)

- **CIRAS pinpointed a management failure which would have caused major injury and/or long term ill health for staff**
- **Corrected-more savings**

GNER

Costs/Benefits (5)

- **Better understanding of the types of diagram which cause fatigue**
- **Diagrams amended without extra cost**
- **Win-Win**

Exploiting CIRAS

- Database has grown to a size where meaningful analysis begins to be possible.
- What questions to ask????
- Dialogue with Strathclyde Researchers needed
- How to use the data-example in packs

GNER

Summary

- **CIRAS works**
- **It is not an easy process**
- **It challenges management**
- **It drives cultural change**
- **It is worth the hard work**
- **It is capable of further development**

International Rail Safety Conference

2000 LONDON

8 November - 10 November 2000
Forum Hotel, London, United Kingdom

Paper 0030

Hans Ring

Is Railway Safety at Risk?

Publisher
2000 International Rail Safety Conference

International Rail Safety Conference

Hans Ring

Director Safety, Head of the Safety Department

Swedish National Rail Administration

<u>Is Railway Safety At Risk?</u>

International Rail Safety Conference 2000

Mr. Hans Ring M.Sc.
Director Safety
Head of Safety Department
Swedish National Rail Administration

E-mail: hans.ring@banverket.se
Phone: +46 243 44 54 12
Fax: +46 243 44 55 22

Theme: Informing Public Understanding and Expectations on Railway Safety

Title: IS RAILWAY SAFETY AT RISK?

IS A GOOD SAFETY RECORD A PROBLEM WHEN AN ACCIDENT OCCURS?

We have found that despite a good safety record the demand for zero risk is increasing. Why? We have performed a number of surveys to find out how media react to different situations.

It seems as if we are going in the wrong direction when we try to limit the number of railway accidents. E.g. ten years ago we had 100 accidents in level crossings. Every year 30 people were killed in those level crossing accidents.

Ten years ago we had limited media interest in level crossing accidents. At that time we started off a program for reducing the number of accidents. Level crossings were fitted with automatic half barriers. Crossings were closed and new safer ones replaced some of them or being transformed into grade separated crossings. We also introduced an information program for motorists. We informed media about the campaign to come. But they were not so interested. It seemed as if many people felt that level crossing accidents were serious but also had to be accepted as a part of everyday life.

We succeeded in reducing the number of accidents from 100 to 30 per annum. As a result of this we are down to 10 killed people instead of 30. But, how did media react to this? What did they focus on? Well, it was not on the reduction. Earlier level crossing accidents were just numbers and figures, bud now when the numbers are down almost every single accident seems to be in focus.

Might there be that a good safety record is bad for you? Think of the railway overall safety record that is very good in most countries. In spite of the good records one single rail accident is much more interesting to media than several car crashes. There might even be several fatalities (more than in the rail accident) on the roads during the period of media attention following a rail accident.

Following a series of severe rail accidents in the late seventies we in Sweden introduced an Automatic Train Protection (ATP) system. The ATP system has since introduction been very successful. However, no single system can protect you from all kinds of rail accidents and again we experience that media focus a lot on those few accidents that still occur.

Railwaymen often find the situation a bit awkward. They think that railway transportation is very safe and do not want to accept that media report on the "unsafe rail" when an accident occurs.

So, who is wrong and who is right? I think that we have to accept that rail crashes will become more and more interesting to media the fewer we get as we continue to improve safety.

This means that you can not only work on improving safety in real life. You also have to work on better public relations and to increase information in between accidents. Tell media what you are doing even if there has not been an accident. Follow up on measures after an accident.

Unfortunately, you will experience that very few journalists will report on your safety improvements. But do not give up. The journalists and the public will be much better prepared to respond to and look for relevant facts when that serious rail crash happens. This is due to the fact that now they have been accustomed to how and under which premises the railway industry works. They have also learnt that you are constantly striving for safety improvements. Hopefully, you will eventually succeeded in your objective that media should have at least some degree of confidence in your professional work.

WHAT DO THE PUBLIC EXPECT FROM YOU? IS IT POSSIBLE TO GET THE PUBLIC TO ACCEPT OTHER THAN ZERO RISK?

What do the public expect? Well, your rail passengers of course expect safe travelling by train. But also those not going by train but living next to your tracks expect your business to be safe. Then we have all people like motorists and children on their way to and from school using level crossings.

To summarise, a lot of people are affected by how safe rail is. Many of them do not have but disadvantages from the railways. They are exposed to risks but do not have the benefits of rail transportation.

No, it is not possible to get the public to accept other than zero risk. But, people will understand realities and if you can show them "why and what" you will have a pretty good chance of being regarded as a partner working for safer rail transportation, rather than a potential madman. If you play it professional - and also if you are a bit lucky - you will get media and the public to share your professional judgement of what are the issues to focus on to get an efficient and financially sound increase of your company's safety level.

If you play it the other way around i.e. if you tell media that your company has such a good safety record that no more action is needed, then you really are a target for media. What a scope for them!

WHAT ROLE SHOULD THE DIFFERENT RAILWAY INSTITUTIONS PLAY WHEN A RAILWAY ACCIDENT OCCURS?

We in Europe have separated infrastructure management from train operation in a number of countries. Quite often those split businesses have been transferred into different companies or government bodies. This is the case in the UK and in the Scandinavian countries and a number of other countries as well.

Even if you have not carried out a separation like this a number of countries around the world have independent accident investigation bodies. And there might be other governmental bodies like a Railway Inspectorate, a Department of Transport etc.

The public expects the governmental bodies to act against poor safety performance whenever this occurs, also in between accidents. When an accident occurs the governmental bodies are supposed to issue recommendations regarding the necessary safety improving measures. Thus, the role for these bodies is clear and easy to grasp.

Regarding train operation companies the public is more suspicious about what the actual main objective of the company might be. Maybe the company wants to make money on the expense of safety ... Most certainly, this is on peoples minds if an accident occurs.

Many infrastructure managers (IM) are unknown to the public and when a serious accident occurs people start to ask themselves "What is this? Why have not I heard of this company before?" If people have heard of the IM company before it is often due to some fuzz or dispute.

Is this good for the railway market? No, of course not. Media is always interested in disputes. They focus on who is bad and who is the good guy. Media have a good chance of finding, or even worse stimulating to a fight between different actors if the market is open to competing companies. Another front-page issue is the little man fighting the big company or if he is stuck in the company's bureaucracy.

It is easy to think that it is good for you if the bad guy turns out to be another player than your company. But, in the long run disputes will harm the whole of the railway industry. People will not remember who was bad and who was good and if disputes occurs now and then people will remember nothing but that rail transportation makes you feel uncomfortable or worried.

So, what should you do? Every party should seek for company improvements. Do not sit back and wait for the authorities to judge who is to blame. If you are a company do your own corporate investigation to find out what went wrong in your corporate routines etc. Try to exchange information with other companies involved in the accident. But do not examine their deficiencies. It is for the governmental investigation body to do that. Remember that media likes nothing better than a dispute. By collaborating all involved companies will gain confidant. Also, do not hide information from the public. If you think it is hard for you to tell media about your shortcomings it will be even harder for you if they find out it themselves. If media catches you red-handed their next question will always be - "What more do that company hide from us?" Now you will be chased like a fox in hunting season. Even when you do tell the truth no one will believe you at first.

When at its best the market will play it straight. Try not to put the blame on others even if they should deserve it. Everyone can improve their business and it is to your benefit if you find out what that would be in with regards to your current financial situation by performing an internal corporate investigation.

MEDIA IS GETTING MORE AND MORE INTERNATIONAL

A railway accident in one country in Europe will have effects also in other neighbouring countries. We have learnt a number of lessons from this.

It is very important to recognise that the public will start to ask questions as soon as they get to hear about the train crash or whatever has happened. People want to know: "Can it be such an accident here, in our country? What have the rail companies done to prevent such an awful accident from happening here?"

Railwaymen will also start to ask the same questions and come to think of it, also safety experts will do the same. So, what can you do is to prepare yourself to such situations. Get to know the basics about other railway systems. What things are different and what have you in common?

Also, we have found that international contacts with colleagues are very useful and important in cases like this.

As said earlier, it is very important that media know whom to ask. Who should know? By connecting media to the right person, hopefully you will stop media from asking people that know less but are willing to talk even about things they do know nothing or little about.

Be prepared. Always speak to media and worried people. If you do not, they think that you hide something from them. Even if you do not know the answer you can gain a lot if you are prepared to find out from experts, rather than letting media hunt for themselves (You never know who they get hold on and what that person will tell them in affect).

HOW DO WE COMMUNICATE RISK WHEN THERE HAS NOT BEEN ANY ACCIDENT?

What do we do to facilitate communication with the public and other players in the railway market? It is very important to feed media with news about new actions aimed at improving safety, even if there has not been any serious accidents for a while. Preferable, you can inform media about the safety benefits related to other improvements like when introducing a new faster service or when opening a new upgraded line etc.

Likewise, it is important to inform media about the current safety level. That even if is not improving the way you have thought it would. But, be sure to analyse why you have not improved and what actions you plan to take, before telling media about the bad news.

Let media know who your experts are in the period in between accidents. This way they can get to know each other and then you can be ascertained that media will at least try to listen to your experts when later on a serious accident occurs. Hopefully some media covering to accident will then be publishing more balanced and true articles about the current situation, being less speculative.

Then we have the local issues. The public often wants to know about safety when something new appears in their neighbourhood like a new railway line or a change in rail services. Another issue of great concern to local people is transportation of dangerous goods.

Try to face peoples worries. Remember that local people often do not get any benefit from changes in the rail system (especially not with transportation of dangerous goods), they are just stuck with the risks associated with it.

This might be one of the most difficult situations to appear. Very often people that do not want that new railway line next to their homes tends to look for serious things that can help them to stop the railway from proceeding with the actual project. Usually this means looking for safety or environmental risks. You would be surprised with what people can come up with if they really are determined to stop you.

In cases like this it is even more important to take your time to meet people's worries and to inform them about what the risks really are. This includes not only facts and figures (figures tend to get too boring and theoretical) but also to understand what people's worries really is about. You have to act like a human and not like a "thing" without feelings and emotions. If you can reach people and show them that you are listening to them, then this is your starting point for a more accurate and balanced dialogue. It is a never-ending process: Inform - Listen - Understand - Inform and Act - Listen again etc. etc.

International Rail Safety Conference

2000 LONDON

8 November - 10 November 2000
Forum Hotel, London, United Kingdom

Paper 0031

Stewart Francis

The Passengers View of Rail Safety

Publisher
2000 International Rail Safety Conference

International Rail Safety Conference

Stewart Francis

Chairman

Rail Passengers Council, UK

The Passengers View of Rail Safety

International Rail Safety Conference 2000

Mr. Hans Ring M.Sc.
Director Safety
Head of Safety Department
Swedish National Rail Administration

E-mail: hans.ring@banverket.se
Phone: +46 243 44 54 12
Fax: +46 243 44 55 22

Theme: Informing Public Understanding and Expectations on Railway Safety

Title: IS RAILWAY SAFETY AT RISK?

IS A GOOD SAFETY RECORD A PROBLEM WHEN AN ACCIDENT OCCURS?

We have found that despite a good safety record the demand for zero risk is increasing. Why? We have performed a number of surveys to find out how media react to different situations.

It seems as if we are going in the wrong direction when we try to limit the number of railway accidents. E.g. ten years ago we had 100 accidents in level crossings. Every year 30 people were killed in those level crossing accidents.

Ten years ago we had limited media interest in level crossing accidents. At that time we started off a program for reducing the number of accidents. Level crossings were fitted with automatic half barriers. Crossings were closed and new safer ones replaced some of them or being transformed into grade separated crossings. We also introduced an information program for motorists. We informed media about the campaign to come. But they were not so interested. It seemed as if many people felt that level crossing accidents were serious but also had to be accepted as a part of everyday life.

We succeeded in reducing the number of accidents from 100 to 30 per annum. As a result of this we are down to 10 killed people instead of 30. But, how did media react to this? What did they focus on? Well, it was not on the reduction. Earlier level crossing accidents were just numbers and figures, bud now when the numbers are down almost every single accident seems to be in focus.

Might there be that a good safety record is bad for you? Think of the railway overall safety record that is very good in most countries. In spite of the good records one single rail accident is much more interesting to media than several car crashes. There might even be several fatalities (more than in the rail accident) on the roads during the period of media attention following a rail accident.

Following a series of severe rail accidents in the late seventies we in Sweden introduced an Automatic Train Protection (ATP) system. The ATP system has since introduction been very successful. However, no single system can protect you from all kinds of rail accidents and again we experience that media focus a lot on those few accidents that still occur.

Railwaymen often find the situation a bit awkward. They think that railway transportation is very safe and do not want to accept that media report on the "unsafe rail" when an accident occurs.

So, who is wrong and who is right? I think that we have to accept that rail crashes will become more and more interesting to media the fewer we get as we continue to improve safety.

This means that you can not only work on improving safety in real life. You also have to work on better public relations and to increase information in between accidents. Tell media what you are doing even if there has not been an accident. Follow up on measures after an accident.

Unfortunately, you will experience that very few journalists will report on your safety improvements. But do not give up. The journalists and the public will be much better prepared to respond to and look for relevant facts when that serious rail crash happens. This is due to the fact that now they have been accustomed to how and under which premises the railway industry works. They have also learnt that you are constantly striving for safety improvements. Hopefully, you will eventually succeeded in your objective that media should have at least some degree of confidence in your professional work.

WHAT DO THE PUBLIC EXPECT FROM YOU? IS IT POSSIBLE TO GET THE PUBLIC TO ACCEPT OTHER THAN ZERO RISK?

What do the public expect? Well, your rail passengers of course expect safe travelling by train. But also those not going by train but living next to your tracks expect your business to be safe. Then we have all people like motorists and children on their way to and from school using level crossings.

To summarise, a lot of people are affected by how safe rail is. Many of them do not have but disadvantages from the railways. They are exposed to risks but do not have the benefits of rail transportation.

No, it is not possible to get the public to accept other than zero risk. But, people will understand realities and if you can show them "why and what" you will have a pretty good chance of being regarded as a partner working for safer rail transportation, rather than a potential madman. If you play it professional - and also if you are a bit lucky - you will get media and the public to share your professional judgement of what are the issues to focus on to get an efficient and financially sound increase of your company's safety level.

If you play it the other way around i.e. if you tell media that your company has such a good safety record that no more action is needed, then you really are a target for media. What a scope for them!

WHAT ROLE SHOULD THE DIFFERENT RAILWAY INSTITUTIONS PLAY WHEN A RAILWAY ACCIDENT OCCURS?

We in Europe have separated infrastructure management from train operation in a number of countries. Quite often those split businesses have been transferred into different companies or government bodies. This is the case in the UK and in the Scandinavian countries and a number of other countries as well.

Even if you have not carried out a separation like this a number of countries around the world have independent accident investigation bodies. And there might be other governmental bodies like a Railway Inspectorate, a Department of Transport etc.

The public expects the governmental bodies to act against poor safety performance whenever this occurs, also in between accidents. When an accident occurs the governmental bodies are supposed to issue recommendations regarding the necessary safety improving measures. Thus, the role for these bodies is clear and easy to grasp.

Regarding train operation companies the public is more suspicious about what the actual main objective of the company might be. Maybe the company wants to make money on the expense of safety ... Most certainly, this is on peoples minds if an accident occurs.

Many infrastructure managers (IM) are unknown to the public and when a serious accident occurs people start to ask themselves "What is this? Why have not I heard of this company before?" If people have heard of the IM company before it is often due to some fuzz or dispute.

Is this good for the railway market? No, of course not. Media is always interested in disputes. They focus on who is bad and who is the good guy. Media have a good chance of finding, or even worse stimulating to a fight between different actors if the market is open to competing companies. Another front-page issue is the little man fighting the big company or if he is stuck in the company's bureaucracy.

It is easy to think that it is good for you if the bad guy turns out to be another player than your company. But, in the long run disputes will harm the whole of the railway industry. People will not remember who was bad and who was good and if disputes occurs now and then people will remember nothing but that rail transportation makes you feel uncomfortable or worried.

So, what should you do? Every party should seek for company improvements. Do not sit back and wait for the authorities to judge who is to blame. If you are a company do your own corporate investigation to find out what went wrong in your corporate routines etc. Try to exchange information with other companies involved in the accident. But do not examine their deficiencies. It is for the governmental investigation body to do that. Remember that media likes nothing better than a dispute. By collaborating all involved companies will gain confidant. Also, do not hide information from the public. If you think it is hard for you to tell media about your shortcomings it will be even harder for you if they find out it themselves. If media catches you red-handed their next question will always be - "What more do that company hide from us?" Now you will be chased like a fox in hunting season. Even when you do tell the truth no one will believe you at first.

When at its best the market will play it straight. Try not to put the blame on others even if they should deserve it. Everyone can improve their business and it is to your benefit if you find out what that would be in with regards to your current financial situation by performing an internal corporate investigation.

MEDIA IS GETTING MORE AND MORE INTERNATIONAL

A railway accident in one country in Europe will have effects also in other neighbouring countries. We have learnt a number of lessons from this.

It is very important to recognise that the public will start to ask questions as soon as they get to hear about the train crash or whatever has happened. People want to know: "Can it be such an accident here, in our country? What have the rail companies done to prevent such an awful accident from happening here?"

Railwaymen will also start to ask the same questions and come to think of it, also safety experts will do the same. So, what can you do is to prepare yourself to such situations. Get to know the basics about other railway systems. What things are different and what have you in common?

Also, we have found that international contacts with colleagues are very useful and important in cases like this.

As said earlier, it is very important that media know whom to ask. Who should know? By connecting media to the right person, hopefully you will stop media from asking people that know less but are willing to talk even about things they do know nothing or little about.

Be prepared. Always speak to media and worried people. If you do not, they think that you hide something from them. Even if you do not know the answer you can gain a lot if you are prepared to find out from experts, rather than letting media hunt for themselves (You never know who they get hold on and what that person will tell them in affect).

HOW DO WE COMMUNICATE RISK WHEN THERE HAS NOT BEEN ANY ACCIDENT?

What do we do to facilitate communication with the public and other players in the railway market? It is very important to feed media with news about new actions aimed at improving safety, even if there has not been any serious accidents for a while. Preferable, you can inform media about the safety benefits related to other improvements like when introducing a new faster service or when opening a new upgraded line etc.

Likewise, it is important to inform media about the current safety level. That even if is not improving the way you have thought it would. But, be sure to analyse why you have not improved and what actions you plan to take, before telling media about the bad news.

Let media know who your experts are in the period in between accidents. This way they can get to know each other and then you can be ascertained that media will at least try to listen to your experts when later on a serious accident occurs. Hopefully some media covering to accident will then be publishing more balanced and true articles about the current situation, being less speculative.

Then we have the local issues. The public often wants to know about safety when something new appears in their neighbourhood like a new railway line or a change in rail services. Another issue of great concern to local people is transportation of dangerous goods.

Try to face peoples worries. Remember that local people often do not get any benefit from changes in the rail system (especially not with transportation of dangerous goods), they are just stuck with the risks associated with it.

This might be one of the most difficult situations to appear. Very often people that do not want that new railway line next to their homes tends to look for serious things that can help them to stop the railway from proceeding with the actual project. Usually this means looking for safety or environmental risks. You would be surprised with what people can come up with if they really are determined to stop you.

In cases like this it is even more important to take your time to meet people's worries and to inform them about what the risks really are. This includes not only facts and figures (figures tend to get too boring and theoretical) but also to understand what people's worries really is about. You have to act like a human and not like a "thing" without feelings and emotions. If you can reach people and show them that you are listening to them, then this is your starting point for a more accurate and balanced dialogue. It is a never-ending process: Inform - Listen - Understand - Inform and Act - Listen again etc. etc.

International Rail Safety Conference

2000 LONDON

8 November - 10 November 2000
Forum Hotel, London, United Kingdom

Paper 0032

Ian Naish

Informing Public Understanding and Expectations on Railway Safety

Publisher
2000 International Rail Safety Conference

International Rail Safety Conference

Ian Naish

Director

RPIB

Transport Safety Board of Canada

Informing Public Understanding & Expectations on Railway Safety

Ian Naish

Informing the public, assuring their understanding and meeting their expectations for railway safety — an investigation agency perspective

Introduction

In order to have completely informed public understanding relating to railway safety, I believe that the method of communication and the substance of the message are the essential elements. Without good communication, we cannot inform and educate the public to the extent that they will comprehend safety issues. (In this paper, I have taken the liberty of considering all persons with whom we deal as "publics", since we have to be consistent in our approach).

The intent of my paper will be to explain our agency's communication process. It will include five brief case studies to demonstrate how the process has worked and what lessons we have learned. Additionally, I propose to give my personal perspective, as an officer in the TSBC, on relationships between our agency and the other interested organizations or groups, as well as among those organizations and groups. Finally, I will attempt to propose some areas where all of those people with an interest in safety can improve their communications. (I should point out that the views stated in that section are mine, and do not necessarily represent the views of our organization).

In Canada, the TSBC has, perhaps, a unique perspective on safety communications, since our mandate is very simple. Our mandate is to investigate selected transportation accidents and incidents, make findings as to causes and contributing factors, identify safety deficiencies and make recommendations to eliminate or reduce these deficiencies, and, finally, to report publicly on our investigations and findings. Our sole object is to advance transportation safety. In theory, we are completely independent of outside influences.

One of our agency's core values is openness. We try to apply that value when we communicate with the various interested organizations and groups in the business of rail safety. Unfortunately, one of the drawbacks in our business is that we have information that should never become public, for example, information of a personal nature (restricted by Canada's Privacy Act). Additionally, if we communicate any hypotheses we are considering during the investigative process, that can easily lead to other organizations making their own, frequently erroneous, conclusions about the causes of the accident.

Four of the five cases I am citing refer to communication problems/challenges in investigations, the fifth refers to a communications issue at a meeting I attended.

I should note that we assess the potential for investigations based on a Board policy document which outlines when and when not to investigate, and which also allows significant leeway for staff to make the decision.

Case 1. Accident involving a derailed freight train carrying dangerous goods in the province of New Brunswick, in eastern Canada. (this occurrence became a basic file data gathering exercise, but should have been a Board investigation)

The province of New Brunswick is one of our smaller provinces, both in size and population, the latter being under one million persons. Local events are well reported across the province.

This accident took place on a Sunday evening, in May, 1999 when the 4600 ton train was passing over recently rebuilt track. Thirteen railcars were derailed out of the 71 car train. The railway company notified us of the derailment almost immediately, as is required by our regulations, and we assessed the situation based on what we had learned from that notification. The report was that there had been a freight train derailment in a small town (pop 1518), but there were no injuries. Although the train had been carrying some dangerous goods, there were no leaks reported. We advised our only investigator in the region about the accident, but, since there did not appear to be any urgency, the deployment to assess the situation was delayed until Monday morning.

Unfortunately, we were not aware that, because there had been dangerous goods cars on the train, the local fire chief had decided to evacuate residents of 150 homes in the vicinity of the derailment site on the Saturday evening.

By the time our investigator reached the site, the media were there. After collecting information and assessing the situation, he was of the opinion that any safety lessons learned from doing a complete Board investigation would be minimal. Consequently, he indicated to the media that we would probably not be doing a Board investigation. This statement, of course, was printed in the editorial sections of the local and regional newspapers, causing us a lot of "damage control" problems at Head Office. We were portrayed in the New Brunswick media as an agency which didn't care about small towns in eastern Canada but only investigated major, more "newsworthy" accidents.

The media appeared to be setting the town mayor against us, from what was appearing in the newspapers. As a result, I made a telephone call to the mayor of the town, indicating that, although we were not doing a Board investigation, we were still collecting file information and, if we found any safety issue, we would be taking action to communicate that. I followed up with his office on several other occasions to ensure that he was kept abreast of developments and to check on his level of comfort with the ongoing process.

In hindsight, the basic problem was the absence of information, in the initial accident report, on the decision to evacuate part of the town. We have often found that a significant part of the information in the initial report can be erroneous, or have contradictory information or lack some key information (The initial media information presented on the German ICE train accident of 1998 is a European example). Because we were unaware of the evacuation, we delayed deployment, with the investigator arriving on site the following day. Secondly, we did not follow our occurrence classification policy, which, although not mandatory, suggests we investigate if there are sound political reasons to do so. In this case, because of what had happened in the town (evacuation of residents and the presence of media), we really had no choice and should have decided to investigate once we knew the situation on site.

In other words, if there is a strong public expectation that we should investigate, then we should do so. If not, we will be criticized publicly by the media and elected local, provincial or federal officials. This in turn means that we lose credibility with the general public and elected officials, which causes problems when we launch our next high profile investigation. The only way to have emerged from the initial deployment without doing a Board investigation, and yet not cause public perception problems, would have been to say we were still assessing the situation and had not yet decided whether to investigate.

Case 2. Passenger train derailment and collision with stored dangerous goods railcars in southern Ontario.

In April, 1999, a VIA Rail Canada passenger train, travelling at 128 km/h, in non-signalled double main track territory in southern Ontario, unexpectedly encountered a reversed main track switch. Both crew members in the locomotive cab were fatally injured and 77 persons (passengers and on-board service crew) were seriously injured.

Southern Ontario is a prosperous, relatively densely populated area of Canada, extending west from Toronto to the US border at Detroit in the west. News coverage is generally intense.

Since this was a major accident, we deployed a large, ten person, investigative team to the site. This team included a public affairs officer, as well as technical experts. The role of the public affairs officer was to act as a liaison person with the media. However, one of the major tasks of the Investigator in Charge (IIC) is to communicate with the media, including television reporters. Without sensationalizing anything, each day, the IIC explained the facts that we had already determined, but refused to be drawn into speculating about the causes. At the same time, we had enough members of the team to allow on site investigation work to continue and to conduct witness interviews.

In another area, that of communicating with the families of the bereaved, two people arrived on site the day the morning after the accident and laid a wreath beside the track within our exclusion zone. One of our investigators was somewhat concerned by this situation and wanted to tell the people to leave the site, but he was astute enough to discuss the situation first with the IIC. As a result, the decision was made just to approach them, talk to them and then let them leave when they were ready. We did leave one of our investigators with them while they were on site. However, they were not considered to be in a position of danger, nor impeding our work. This was probably the best approach, since a less sensitive attitude would no doubt have resulted in negative publicity.

Case 3. Passenger train collision with a tractor trailer at a private crossing in a remote area of Ontario.

The long distance train was carrying around 200 people and the initial report was that there had been an explosion and there were injuries.

We again deployed a large amount of resources (seven people), which was perhaps too many. Because site access was difficult, logistics was a challenge. The fastest time for staff to get on site was seven hours from deployment. Communications between TSB officials, the railway owning the track and the passenger train company off-site were also difficult. Later it transpired that injuries were minimal and non-severe, the explosion was that of the truck's fuel tank which had scorched the side of the locomotive and the first coach, which was a baggage coach. The single main track line is the company's principal east-west main line in Canada.

We had asked senior officers of the company owning the track to record, by film (either camera or videotape), the internal conditions of the passenger coaches prior to moving any of the equipment, and they had agreed. However, their officers on site either did not get the message, or decided not to make any film record, despite the commitment. Although we had asked that the train not be moved until the first investigators had arrived, part of it was moved. This resulted in conflict between our investigative team and some railway officers. We insisted, on our arrival, that on the passenger coaches which had been removed from the site being reattached to the train for photographic documentation purposes. In hindsight, this could be considered as an overreaction, but it was understandable from the perspective of an unfolding investigation. It was fortunate, from a public affairs perspective, that the accident occurred in a remote wilderness area and access was through forest company property. This minimized media coverage of the accident and allowed the investigation to proceed without the media "glare".

The lesson of this investigation to me was that, even with the best intentions, organizations cannot always live up to their commitments, especially when events are very time sensitive. Additionally, companies operating over the tracks of other companies may have different priorities (for example, a passenger company's priority is to evacuate their passengers, retrieve their possessions and get them to their destinations, a track owner's is to clear the track to get backed-up freight traffic moving again to minimize economic penalties). Our priority is to "freeze" the site, to get there as fast as possible and record the perishable information as quickly as possible. Looking back at the event, it is clear that we deployed too many investigators too soon, which added to the complexity of what was to become a relatively simple investigation. Because of the complexity of the communications situation, we will be more careful in the future and perhaps deploy fewer investigators initially. When we do, we will ensure that frequent contact will be made with senior railway company officials at the start of the investigation and check that all organizations are talking, on and off site. Otherwise, we may end up with interpersonal problems when the next accident occurs.

Case 4. Derailment and collision of a dangerous goods train.

This was a significant occurrence last December 30. A train loaded with petroleum products, in double main track territory, heading westward to Montreal derailed just as it was being passed by an eastward train carrying mixed freight. The resulting collision and explosion resulted in the deaths of the two crew members of the mixed freight train, explosions and fires which consumed two thousand tons of fuel and resulted in the evacuation of 800 people from the vicinity of the site.

The unit train in question has been the subject of intense political debate within Quebec since it started operation in 1997. The train carries home heating oil or gasoline. The train consists of multiple sets of 17 cars, with each set of cars carrying one product only. The cars are loaded and unloaded at one point per 17 cars. The operation is between Quebec City and Montreal, and typically runs once a day, six days a week.

Because the accident occurred just before the worldwide millenium celebrations, it was not as big a media "event" across Canada as it might otherwise have been. In the province of Quebec, however, there was intense media and political activity related to the event.

Although our rail branch has 20 investigators in total, only two are based in the Quebec region. However, we put together a team of four francophone investigators and a public affairs liaison officer who deployed to the site, with one of our investigators designated to handle the media. Besides the problem of investigating under intense cold conditions (windy and - 25 Celsius) the challenge in this investigation was to manage the intense political / public scrutiny in Quebec over the following weeks. What significantly assisted us was the interest of our Chairman, the Hon. Benoit Bouchard, who is a former federal Minister of Transport, former Ambassador to France and a very well known and respected Quebecker throughout Canada.

Three weeks after the accident, Mr. Bouchard chaired several public meetings with mayors of municipalities along the train's route and, assisted by the IIC, explained our mandate, our approach to investigating the accident and what we had determined to that point. These meetings had the effect of diminishing any general public concern about how the investigation would be handled.

There were some problems with the regulator's inspectors at the start of the investigation. Their staff had arranged witness interviews before us and wanted to continue to do so. Our investigators prefer to talk to witnesses first, since there is a possibility of "chill" when crews have been interviewed by their company or by regulatory officers who can take disciplinary measures against the company and their crews. In comparison, our legislation states that our role is not to assign blame, primarily because we believe that if we did, it would reduce witness openness and cooperation. Both we and the regulator have strong statutes, but ours has paramountcy when there is a conflict. However, the regulator's officer had instructions from his manager to interview the crew as soon as possible and refused to wait. The problem was resolved at a higher level, but some interpersonal conflicts remained at the staff level.

Case 5. Communications in a multi-organization meeting

Several months ago, I attended a meeting where various interest groups, including regulators, representatives of different transportation modes, unions and other agencies attended to talk about transportation safety initiatives currently underway. At one point, there was a question posed by a (non-railway mode) member of the audience about some rules that the railways were about to propose. Unfortunately, the railway spokesperson stated that he was not prepared to say anything about it and remained silent on a follow-up question. From my perspective that was not the most positive message to transmit in that forum. It left me with the impression that the spokesperson was not being open and perhaps had something to hide. It would have been quite easy to explain that, for example, decisions had been made in various areas, but not in others and give an expected time for completion. (That is the approach we try to take for our communications with other organizations when we comment on the progress of accident investigations).

Lessons Learned

While the specific approaches we took to the investigations were determined case by case, the common threads to investigating successfully while managing communications at the same time are, in my opinion, the following:

1. Assure that decisions made at the time of initial deployment can be modified to incorporate information forthcoming later on.

2 Be as open as possible with all other interested organizations and ensure that they are in agreement, or at least will comply with our approach, both to performing the investigation and to dealing with the media/ general public.

3. Release key factual information during an investigation as soon as possible, once the data are verified, through a single spokesperson. This will ensure that the other organizations, including the media and the general public, are abreast of the issues.

4. Don't speculate as to causes when talking to the media. That can easily disrupt an investigation.

4. Try to avoid interpersonal conflict. If it occurs, and cannot be easily resolved, the issue should be referred to senior management. We (investigators, regulators, unions, industry) all need to communicate on safety related matters on a day to day basis and there is no value in creating unnecessary conflicts.

5. Key contact persons should be established for each organization whenever there is a complex investigation underway.

6. Credibility of a spokesperson can be questioned where there is a refusal to answer questions. On the other hand, it must be recognized that some members of the media want to go along a path of questioning which might not be that which will best serve our interests.

7. Recognize the personal nature of the feelings of bereaved families and try to console and accommodate them as much as possible.

The second part of my paper deals with the various organizations who are involved in the process of improving understanding in order to meet the general public's expectations for safety. I will identify briefly each organization or group and examine the issues which may explain the reason for their particular behaviour regarding safety communications.

1. General Public

The public's understanding of rail safety comes from what they read, hear and see in the media, as well as from personal or acquaintances' experiences. Their perception of risk is based on these inputs. They want to know that passenger train travel is safe and that the transportation of dangerous goods by rail poses no threat to their environment. If they live near a rail line, they are very sensitive to the possibilities posed by a derailment. They appear generally to have no interest in the probabilistic explanation of risks (just as I know that nuclear power stations are said to be safe but have no wish to live anywhere near them!)

2. Media

The media's role is to sell stories. Ideally, they should be informing, educating and entertaining at the same time. However, one of their successful ways of selling their product can be by sensationalizing or creating controversy. Entertainment can then become the priority, not a balanced depiction of the situation. The western world's perceived need by the media for instant information, and the knowledge that negative news sells, appear to be the motivators for the approach. Media's perception of other interested groups and organizations is that the latter are all potential sources of the "sound bite" or "quotable quote" which can put these organizations immediately into conflict with any of the other groups.

All of our investigators undergo media training, primarily to ensure that they state just facts, avoid speculation and the traps that some reporters like to set. For example, we are often asked if we think a certain railway company is safe for the movement of goods or passengers. As far as we are concerned, that is the business of the regulator to answer, since we are investigating one accident and may not have identified a systemic problem, but perhaps like most people, our investigators sometimes try to help out by answering all questions posed. This can cause problems with both regulators and industry.

3. Industry

Clearly, profit is the motivator for all businesses if it wants to continue operating in a competitive environment. Just as clearly, if safety in the rail business is a problem, shippers will shift traffic to a less risky company or mode and the railways will lose money. In North America at least, there is some impression that the rail industry is not as open as it could be, perhaps from the industry's cultural values. Industry's perception of government appears to be somewhere between an ally in the quest for safety and an enemy to the march of progress.

If we segment the industry into the major railways and the short-line and regional railways, because of the relatively low serious accident rate on the major railways, the industry is generally perceived as safe, except when a major accident occurs. There can be a perception that short lines and regionals are "less safe", perhaps because they are perceived as having less capital to invest in their operations, less, multi-tasked staff to focus on the safety issues and have often taken over undermaintained secondary lines of major railway companies. I believe that the public expectation would be that the major railways set a safety example to the short line / regional railways, since the general public's image of the business is that of the Class I North American railways.

4. Unions

Unions have three main roles: maintain or increase the number of members, obtain the best possible contracts and working conditions for their members and enhance their level of workplace safety. Some, but certainly not all, North American rail unions perceive management as sacrificing worker safety for short-term profits and continue in a state of conflict with industry management. At the same time, because of the structure of the industry, a significant number of train crews work as long as possible if there are financial benefits to doing so, even at the cost of fatigue and therefore safety. Some union executives, and perhaps the members too, can perceive government as either uninterested in union concerns, because of overriding economic considerations across the country, or else as more focused on the economic side of regulation than safety, in other words, being "on the side of railway management".

5. Government Regulators

Regulators have several objectives: one is safety, one is economic considerations and one is to ensure the Minister is not embarrassed. Within the Department, while technical/professional staff tend to want immediate regulatory action on newly identified safety threats, senior management wants a more sober, analytical approach, possibly with discussions with industry prior to taking regulatory action.

6. Family

Families of victims of transportation accidents are grieving, often angry at everyone and want to have an explanation of what happened and why. The anger can be focused on any one of the other interested organizations. Media, fortunately or unfortunately, can act as a conduit for their expression of sorrow or anger as they search for a person or organization to blame for the tragedy (including ours). Family members need an outlet and also need a message that we care about their situation.

Suggestions for improving communications to members of the IRSC

1. Industry

My recommendation to industry would be to be more open, both to the public and to their employees. When spokespersons refuse to comment on issues, there is an impression that something negative is being hidden. Additionally, I suggest that industry recognize that management's interests are best served by the business operating safety, as are the regulator's and the unions'.

2. Unions

Acknowledge to other organizations that there can be conflicts between members' remuneration versus members' safety within their organizations, and not confuse maximizing union membership as equivalent to assuring a high level of safety. As noted in 1 above, I would recommend that unions recognize that their interests, railway management's interests and the regulator's are also best served by safe rail operations. As such, try to work in a cooperative environment as much as possible.

3. Regulators

The best way to protect the Minister's interests is not to waffle when talking to the media, but take prompt action when necessary and clearly communicate what has been done, or, if not, why not. Safety is good business in the long run, even though an economic cost may occur in the short term.

4. All

When communicating on a specific issue, a single voice will present a more coherent message than several spokespersons.

Communicate safety related information as quickly as possible once it has been confirmed.

2000 LONDON

8 November - 10 November 2000
Forum Hotel, London, United Kingdom

Paper 0033

Bill Casley

International Rail Safety Conference
CD Project
Report to Delegates

Publisher
2000 International Rail Safety Conference

International Rail Safety Conference

Bill Casley

Director

Bill Casley Consultants Pty Ltd, Australia

CD Project - Report to Delegates

Paper for presentation at the Eleventh International Rail Safety Conference, London, Great Britain 8-10 November 2000

REPORT TO DELEGATES

CD PROJECT

INTERNATIONAL RAIL SAFETY CONFERENCES, 1990 - 1999

W. S. Casley

REPORT TO DELEGATES

CD PROJECT
INTERNATIONAL RAIL SAFETY CONFERENCES, 1990 - 1999

CONTENTS

REPORT TO DELEGATES

CD PROJECT

INTERNATIONAL RAIL SAFETY CONFERENCES, 1990 - 1999

1. Introduction

In response to a number of inquiries regarding the availability of previous conference papers, the delegates to the 1999 Tenth Conference in Banff, authorised Bill Casley (Consultant) and John Hall (NSW Department of Transport) to coordinate the establishment of the CD Project.

The project is not intended to be a profitable commercial enterprise but rather a non-profit cooperative exercise aimed at facilitating the archiving of conference papers from former conferences. In this regard the objective of the project is to locate all the previous papers; collate them into a suitable electronic format (CD) and, to produce and supply copies of the CD for the exclusive benefit of delegates of past and future conferences.

It is pleasing to report copies of all previous published conference papers have been located.

2. Purpose of Paper.

The purpose of the paper in the first instance is to report progress to the conference delegates in relation to the CD Project. Secondly, to obtain amongst other things, the conference delegates' approval regarding the formalisation of production and distribution arrangements.

3. International Rail Safety Conference – A short history

The conference originated from within the organisation of the East Japan Railway Company. Following a series of serious railway incidents, which occurred on the company's railway, discussions between the Railway's Management and the executive of the East Japan Railway Company Union led to the concept of establishing a rail safety conference as a means of discovering fresh ideas on railway safety.

Approaches were made to other railways throughout the world to establish if there were common links regarding the safety issues then facing the company. Following the receipt of a number of favourable responses, it was considered that a conference, where participants openly shared their knowledge regarding rail safety issues, would be beneficial to the aim of improving rail safety generally.

The inaugural conference was held in Tokyo in October 1990. Twenty one delegates presented a range of papers, these delegates came from a broad range of backgrounds involving Railway Union Executives, Senior Railway Safety Managers, Senior Railway Operational Managers, Heads of Railway Safety Directorates as well as Senior Government representatives from a number of European Government Railways. The delegates also represented a wide range of railway activity from the following countries, Australia, China, Czechoslovakia, France, Germany, Hungary, Japan, Netherlands, New Zealand, Poland, United Kingdom and the United States of America

This ecumenical approach has been maintained as an essential and integral part of each of the conferences, which have subsequently been held each year since the Tokyo Conference Each conference has been designed to ensure that free and open discussion amongst the conference delegates affords the best medium for achieving appropriate solutions for resolving safety issues

The conferences are not intended to achieve commercial gain for any of the participants but rather an opportunity for delegates to freely share their views and experience on pertinent safety issues Consequently, participation in the conference is by invitation only

The conference host is responsible to ensure that participation is balanced and the established requirement of the conference, ***that participants shall present an appropriate paper***, is achieved. Observers, at the discretion of the host, have also attended the conferences but generally these observers have not been permitted to enter into any formal debate held amongst the delegates The number of observers attending any particular conference is naturally determined by the size of the particular venue at the time

World acceptance of the conference is clearly demonstrated by the fact that since its inaugural sessions in Tokyo in 1990, conferences have been held successfully each year at different venues throughout the world

Since its inception the International Rail Safety Conference has been held at the following locations.

1990	Tokyo, Japan
1991	London, UK
1992	Wellington, New Zealand
1993	Angers, France
1994	Hong Kong
1995	Mainz, Germany
1996	Cape Town, South Africa
1997	Lucerne, Switzerland
1998	Sydney, Australia
1999	Banff, Canada

4. Progress to date

It is pleasing to report copies of all previous published conference papers have been located.

In the years 1990 to 1999 there have been 282 papers presented at the conferences. These papers cover a wide range of subjects. Detail of the respective papers is contained in 'Attachment A'. For easy reference this attachment consists of 10 parts, with each part (1 to 10) relating to the respective conferences in chronological order.

Delegates should be aware that some former presenters did not provide written papers, but relied upon video or other display medium to support their presentations. These particular facilities are not available at the present time. Accordingly, under these circumstances we are obliged to content ourselves with preserving the printed medium. Where it is possible to identify presentations that are not supported with a written paper, a suitable comment will be included in the relevant index of the specific conference.

I would like to place on record my appreciation of the efforts of Gerard Churchill (France), Koichi Kawano (Japan), Mark Fynmore (New Zealand) and Johan de Villiers (South Africa) in locating and forwarding to me the necessary copies to enable compilation of a complete set of conference papers.

Thanks are also extended to the efforts of the staff of the NSW Department of Transport in relation to the technical aspects of converting the papers into an electronic format.

Whilst the first hurdle of locating the papers has been overcome, there remains several issues to be resolved before suitable arrangements can be made for the production and distribution of the final product.

5. Issues

The following issues require clarification and direction by the delegates before the project can proceed with the production and circulation of the CDs.

5.1 Copyright

Throughout the world various copyright legislative arrangements exist to provide rights and privileges to the owner of copyright material.

It is an established custom for publications to have a prominent statement with regard to copyright. Several examples of these statements are as follows:

> "Copyright ©"
>
> or,
>
> *"All rights reserved. No part of this publication may be reproduced, stored in a retrieval system, or transmitted, in any form or by any means, electronic, mechanical, photocopying, recording or otherwise, without the prior permission of the publisher."*

or,

"This publication is copyright. Apart from any fair dealing for the purpose of private study, research, criticism or review, as permitted under the Copyright Act, no part may be reproduced by any process without written permission of the publisher."

Consequently delegates need to consider the position facing the CD project with respect to any copyright arrangements regarding the papers presented at any of the International Rail Safety Conferences.

In both the latter examples the following question is raised Who is the publisher of the papers? Is it the host organisation for each conference?

Should the individual papers be appropriately marked regarding copyright? If so, to whom should the copyright be assigned to, the author or his/her organisation? In this regard, it is considered that each individual paper should be marked "Copyright ©", thereby assigning the copyright to the principal of the paper

5.2 Author's Release

A situation, which needs to be considered by delegates, is the question of mitigating potential legal concerns that may arise in the future regarding the use of material, from previous conferences, in the production of the CD.

Consequently the matter of the need for obtaining permission from the Author and/or his/her Organisation to publish the relevant paper(s) needs consideration and direction from the delegates

- Is it necessary?
- If required, by what means should such a release be obtained?
- Can it be accepted that, as the documents have been previously published for distribution at previous conferences, they are now in the "Public Domain" and as such would not require an author's release? If so, it would still be appropriate to advise the respective authors and their organisations of this conference's intention to republish the papers in a CD format

Given that there is a need to obtain an appropriate release, this could be streamlined by a system where nominated representatives facilitate the acquisition of the relevant permission for those papers provided from their country. In this regard it would be appreciated if delegates could nominate a representative for their country and advise Bill Casley before the close of the conference. To enable delegates to identify the scope of this request in relation to their own country; a reference matrix detailing the countries and organisations that have previously supplied papers is included as "Attachment B" The reference numbers used in the matrix refer to the respective papers detailed in Attachment A.

5.3 Format

A proposed format for the CD is contained in "Attachment C".

5.4 Circulation/Distribution

It is proposed that the production and circulation of the CDs be limited to a single production run.

To facilitate the identification of the likely production scale and the distribution spectrum, delegates are requested to indicate their requirements by use of the order survey form attached as "Attachment D".

5.5 Costs

The project is not intended to be a profitable commercial enterprise.

It is a non-profit cooperative exercise aimed at facilitating the archiving of conference papers from former conferences for the exclusive benefit of conference delegates.

Obviously there are production and distribution costs involved. While it is anticipated these can be minimised, final costing can only be determined when the scale of the production and distribution spectrum has been established.

5.6 Formalisation of Project.

Whilst the delegates at the 1999 Banff Conference, during the conference business segment of the final day, were unanimous in their verbal approval for the commencement of the CD Project under the auspices of Bill Casley and John Hall no formal arrangements are in place for this proposal.

Accordingly, delegates are requested to formalise the arrangements for the CD Project as set out in Attachment E.

5.7 Liability

The project team shall execute their responsibilities to the best of their abilities, with all due care and attention. No responsibility is accepted or implied by the members of the CD Project Team in relation to any matter arising from any actions, claims, costs, expenses and damages (including legal costs) in respect of the Project Team's activities to facilitate the archival of previous conference papers and collating these papers into a suitable electronic format (CD).

6. Matters for Resolution by Delegates to the Eleventh Conference

Delegates are requested to confirm their requirements in relation to the following matters

6.1 Formalisation of the CD Project
Delegates reaffirm the Banff Conference decision to proceed with the production of a CD containing past conference papers and approve the formalisation of the project as set out in Attachment E

6.2 Copyright

6.2.1 That this conference endorses the CD Project Group to produce the CD under the auspices of the International Rail Safety Conference and that for the purposes of this project the publisher of the CD shall be the International Rail Safety Conference.

6.2.2 That the cover or label of any publication clearly contain the followi. statement in regards to copyright:

> *"All rights reserved. No part of this publication may be reproduced, stored in a retrieval system, or transmitted, in any form or by any means, electronic, mechanical, photocopying, recording or otherwise, without the prior permission of the publisher."*

6.2.3 Each individual paper be endorsed with the following

"Copyright ©"

6.3 Release
Delegates to this conference agree to facilitate the receipt of the relevant author/organisation release for the publication of individual papers in the project Co-ordination Nominees to be established prior to the close of the 11th Conference

6.4 Format
Delegates confirm the proposed format, as set out in Attachment A is acceptable

6.5 Liability
Delegates of the 11th International Rail Safety Conference acknowledge that in respect of the CD Project Team's activities to facilitate the archiving of previous conference papers by the collation of these papers into a suitable electronic format (CD) and the subsequent production and supply of copies of the CD, no responsibility is accepted or implied by the members of the CD Project Team in relation to any matter arising from any actions, claims, costs, expenses and damages (including legal costs) associated with the CD Project

Attachment A, (Part 1)

1990 TOKYO

30 October - 1 November 1990
Hotel Metropolitan, Tokyo, Japan

INDEX

Folder	Author	Paper
9001		Introduction papers and schedule
9002	Isamu Yamashita	Opening Speech
9003	Schichiro Yamanouchi	Keynote Report I
9004	Georges Dobias	Keynote Report II New concept for railway safety
9005	Jean Louis Meyer	Experience gained by SNCF with regard to the safety of high speed operation
9006	Henk van der Flier	Contribution of psychological tests to railway safety
9007	Dieter Metz	Safety strategy for the man - machine - system railway
9008	Koji Sasaki	East Japan Railway Company Safety Plan
9009	Shin Kanke	Railway Safety for Labour Unions
9010	Kunio Yanagida	Guest Speech - The progress of technology vs. safety "blind spots in the age of big systems"
9011	Tony Boland	Sand - Why Control?
9012	P. Cannito	Road Safety - The Human Factor
9013	Ray Ryan	Safety Management in New Zealand Railways Corporation
9014	David Rayner	British Rail's Safety Management Programme
9015	Yongwen Liu	Maintain the Policy of "Safety First Emphasis on Prevention" in Traffic Operation
9016	Akira Esaka	Guest Speech

9017		Panel Discussion
9018	JR Aizu Wakamatsu station Employees	Questions?
9019	Kazuhiro Niizuma	Building a Workplace Where Workers Initiate Safety
9020	Laszio Machovitsch	MAV Safety Devices

Attachment A, (Part 2)

1991 LONDON

30 October - 1 November 1991
Latimer House, London, United Kingdom

INDEX

Folder	Author	Paper
9101	D.E. Rayner	Safety Budget Prioritisation
9102	Pierre Vignes	The New Concept of Safety in the SNCF Drivers' Management
9103	David Maidment	Monitoring Safety Performance, Individual and Organisation Behaviour
9104	Steve Maxwell David Hyland Jim Kennedy	Ranking of Infrastructure Renewals within a Suburban Railway Environment
9105	Bob Galvin	Introduction of Risk Management into Queensland Railways
9106	D.G. Elms J B Mander	Locomotive Engineer Hazards - A Risk Assessment Study
9107	Unknown	U.K. Legislative Developments
9108	Dieter Metz	Is it possible to quantify the human error rate in railway operations?
9109	R.K. Taylor	Safety on British Rail - Research into the Human Factor
9110	Michel Joing	Feedback on Hazardous or Dangerous Occurrences
9111	Jean-Pierre Macaire	Selection and Monitoring of Safety Staff Aptitudes and Human Reliability
9112	R.S. Ryan D G Elms	Safety and Risk Assessment of the Auckland Light Rail Proposal
9113	R.S. Ryan D G Elms	Risk Assessment Experience - An Overview of Four Case Studies
9114	Unknown	Liverpool Street Redevelopment
9115	R.S. Ryan S Wood	Hazardous Goods Risk Assessment - Scoping Study

9116	R S Ryan M R Hughes	Wellington Urban Train Service - Risk Assessment Scoping Study
9117	Unknown	British Railways Board Safety - Programme Prioritisation

Attachment A, (Part 3)

1992 WELLINGTON

27 October - 30 October 1992
Park Royal Hotel, Wellington, New Zealand

INDEX

Folder	Author	Paper
9201		Programme
9202		Abstracts
9203	P. Messulam	An Historical Flashback of Rail Deregulation
9204	D. Metz	Development of Quality Assurance for Railway Safety
9205	R.S. Ryan M.A. King	Transport Law Reform in New Zealand
9206	D. Rayner	Cost Effectiveness of Safety Expenditure
9207	T. Murakami	JR East's Investment in Safety
9208	M Joing	Determining the Cost of Railway Accidents
9209	A. Boland P. Niven	The Costs of Safety
9210	C Labushagne	Risk profile: A Practical Approach
9211	D. Maidment	The Development of Information Systems to Support Risk Management
9212	G. McDougall	The Cost of Poor Quality
9213	R. Allan	Risk Management Protection Levels at Road/Rail Crossings
9214	J. Rose	Safety and Quality Development in the London Underground
9215	J. Rose	Human Factors Aspect of Staff Accidents - Monthly Report
9216	C. Hall	Strategy for Safety Management
9217	H Nagaoro	Study and Prospect of Humanware

9218	P Messulam	Vigilance for Railway Workers
9219	A Matsuzaki	Railway Safety for Labour Union
9220	C Hall	Care Management of Workers Compensation and Rehabilitation
9221	M Joing	Incident Investigation and Discipline Procedures
9222	D Rayner	British Rail - Human Factors Research and Application - An Update
9223	M. Jones-Lee G Loomes	Monetary Value of Underground Safety Relative to Road Safety
9224	Georges Perec	Untitled

Attachment A, (Part 4)

1993 ANGERS

26 October - 28 October 1993
Hotel Mercure, Angers, France

INDEX

Folder	Author	Paper
9301	Michel Joing	Welcoming Address
9302		List of Delegates
9303		Agenda
9304		Contents
9305	Guy Hoedts	Railway Safety in European Community Legislation
9306	T. Murakami	Administrative Regulation - Railway Undertakers
9307	R. Ryan	Safety Management System in New Zealand Rail Limited
9308	D. Rayner	Safety Case Practice
9309	H. Nagaoka	The accident/incident database and risk assessment study at JR East
9310	Dr. F. Mulke	A holistic approach to loss control in a Metro train service in South Africa
9311	J. Hendriks	Risk analysis method RAM
9312	J. Stuifmeel	Injuries sustained by passengers due to the malfunctioning of the outer doors of train
9313	J. Rose	Staff accident safety analysis
9314	D. Wharton-Street	Working hours related with safety
9315	R. Loncle	Research on human factors : cooperation between SNCF and social sciences researchers. Example : track workers' safety
9316	F. Keravel	Feedback analysis on human error for a better management of risk

9317	D Maidment	Safety Management Training
9318	D. Wharton-Street S Tozer	A proactive system for measuring organisational safety health in a railway environment ("REVIEW")
9319	F. Laporte	The necessity of incorporating the cognitive aspects in accident analysis: an example of a bridgeworker accident
9320	G Churchill	Quantification of safety's jobs at the RATP company
9321	H Miki	Factors of running-over accidents involving subcontractor's workers
9322	M Siebert	Use of the international safety rating system on a railway
9323	R. Blinco	The evolution of safety and loss control in the Canadian passenger rail transportation industry
9324	G. Churchill	Dependability auditing. A new function in the company
9325	G. Lee	The safety audit system of the Mass Transit Railway of Hong Kong
9326	T Murakami	The management of statistics for railway accidents and operations impediments
9327	D. Maidment M Joing	Exchange of Safety data between railways
9328	F. Pinton	Transport of hazardous substances Health and Safety sub committee A British Rail View
9329	F Laporte	Emergency measures plan - Saint Leonard d' Aston a story of communication and cooperation
9330	D Rayner	Evaluation of ATP Benefits
9331	B Cozzi	The implementation of ATP system on SNCF network
9332	J. Swier	The Development of a new level crossings policy in the Netherlands
9333	K. Nolte	Safety of high speed railway tunnels German experiences of planning and realisation of safety measures

9334	P Abbott	Transport of Dangerous Substances: Health and Safety Sub Committee Report. A British Rail View
9335	W S Casley	Rail Safety Act, 24/9/93, New South Wales
9336	D Byrne	Improving Safety Standards in a changing environment

Attachment A, (Part 5)

1994 HONG KONG

31 October - 2 November 1994
JW Marriott Hotel, Hong Kong

INDEX

9415	R.T. Kynaston	Human Factors in MTR
9416	G. Churchill	Procedure Design and Validation
9417	D. Maidment	International Safety Data Exchange
9418	I. Morrice	Railway Regulation in Hong Kong - An Inspectorate Perspective
9419	H. Miki	Strengthening the cab structure - an example of Type 209 EJR train
9420	L. Brearley	A National approach to Rail Safety Regulation - The proposed changes in Australia
9421	M. Brown	Training for Greater Safety
9422	N. Thompson	The New South Wales Rail Safety Act - The first twelve months
9423	P. Anderson	The Dilemma of procuring a Safety Critical System - MTRC's Approach to the Selection of a Replacement Automatic Train Control System
9424	H. Itoh	Violence against JR Workers
9425	R. Brighouse	KCRC ATP Project Safety Management System
9426	G. Ayers	Fire Legislation- Quantified Risk Assessment
9427	T. Murakami	Outline of "Basic Safety Plan Between 1994-1998" - JR East's further challenge to improve safety
9428	Wong Woh Sung	Safety Management in Singapore MRT
9429	D. Metz	Introduction of Safety Audits at German Rail (DB AG)
9430	D. Byrne	Using Safety to Lead the Change in the Management Culture of Railways in Victoria
9431	A. Van Der Bergh	A Holistic View of Integrating Quality, Environment and Safety
9432	R. Ryan	Healthy Systems

Attachment A, (Part 6)

1995 MAINZ

9 October - 11 October 1995
Mainz, Germany

INDEX

9516	M. Ogata	Our creative Safety Measures - Aiming at zero Accident
9517	Dr K. Hauser	Safety at Work
9518	E.C.F. Hung	Combine (Quality and Safety) Audit
9519	D. Metz	Update on the operational supervising System in DB AG
9520	G. Churchill	Organisation of Safety in RATP
9521	G.S. Daniel A D F Pickett	Application of Computer Support to the Management of Emergencies
9522	T. Takeuchi	Union and Management should work together for Railway Safety
9523	J. Lindfield	Untitled Video film - Not available.
9524	F.Q. Callard	Principles of safe movement on Rail - Their origin and Development in Spoornet - South Africa
9525	G. Lee	Development of a Contractor Safety Management System in the Mass Transit Railway Corporation
9526	Dr M.H. Walter	Update on the UK Safety Case Regime
9527	W. C. Kuys	Loss Control on a Mass Rail Transport System
9528	R. Ryan	Railway Safety and the Community in New Zealand
9529	W.S. Casley	Certification of Railway Safety Workers under the New South Wales Rail Safety Act
9530	W.S. Casley	The Regulation of Railways under the New South Wales Rail Safety Act
9531	S. Nakai	Safety Equipment introducing in East Japan Railway Company
9532	L. Orve	Radio Block in Sweden - An economic solution integrating positive train separation via radio and automatic train protection

Attachment A, (Part 7)

1996 CAPE TOWN

7 October - 9 October 1996
The Lord Charles Hotel, Cape Town, South Africa

INDEX

Folder	Author	Paper
9601	D. Rayner	The use of Risk Management Practise in the safeguarding of safety of the privatised Railway Industry in Britain
9602	M Siebert	Railway Safety Case Processes
9603	M. Walter	Railway Group Standards. Present and Future
9604	F Van Eeden	A public health approach to rail related injury control
9605	H. Block	Safety Regulations and their application
9606	C. Erasmus Z.N Jakavula	Management of risk and procedures to be followed after an accident/incident occurs
9607	B Thiel	Rewriting Train Working Rules from first principles
9608	S Robertson	Experience in the UK of a Safety Case Management Regime
9609	A. Roche	Developing a safer railway The role of research in a changing industry
9610	J Steyn L Bradfield	Rail Safety "For Africa from Africa" - An audit with a difference
9611	Wong Who Sung	Safety Audit
9612	G. Churchill	The evaluation of the European Railways safety related certification
9613	M. Kotake A. Olofsson	Risk Evaluation and Risk Assessment at the Swedish National Rail Administration (Banverket)
9614	J. De Villiers	Risk profiling a railway line. The Spoornet experience

9615	Loh Chow Kuang	Project Safety Review: A life cycle approach to Safety Management
9616	P.T.F. Kong	Systems assurance: Design and Implementation
9617	N. Mnisi	Safety awareness at Swaziland Railway
9618	G. Booysen	An Integrated Risk Communication Strategy: A Spoornet Case Study
9619	T. Aikawa M. Horiuchi	A Global Risk Assessment in East Japan Railway
9620	S. Nakai	Promoting safety through exchange of opinions between Top Management and field personnel: General Safety Inspections
9621	H. Miki Y. Kobayashi M. Takahashi	One man operation and safety: The aspect from the Union
9622	M. Mizukami K. Suda M. Takahashi	Unions Tackling: Improvement of one man train operation
9623	A. Dreyer	A holistic, integrated Safety/Risk and Environmental Management System in support of a predictable service; bridging the gap from present to optimal excellence
9624	J. Stuifmeel	Irregularities and accidents in the Railway system
9625	C.A. Thompson	Risk Information Management in Spoornet
9626	B. Jacobs D. Van Zijl	The development of Information Systems for enhanced management of Metrorail infrastructure
9627	P. Lingwall H. Ring	Banverket: Risk Finance and Risk Information System
9628	J. Hendriks	Risk Assessment in the Railned Safety Management System
9629	F.Q. Callard	Implementing Rail Safety as a process in a Railway in Transition
9630	D. Davis	Tranz Rail Ltd's Safety Management System Experiences with the Legal Process
9631	P. Godier	Learning from Safety Incidents

9632	J Lindfield	Developing a Living Safety Case
9633	Lee Kai Wing	Development of a risk control process for Mass Transit Railway
9634	T Worrall	Privatisation or major structural change Two prime risk areas
9635	H Muller	Designing a predictable Train Service
9636	Ho Chun Wing	Managing human factor in practise
9637	D. Reuter	Future organisation of Operations Safety Units Deutsche Bahn AG
9638	B Carver K Moonsamy	Rolling stock upgrades to improve safety and combat vandalism
9639	Leung Kai Wing Li Yun Tai	Platform gap on Kowloon -Canton Railway
9640	J Benech	Safe carriage of hazardous materials
9641	A Smith A Pretorius	The Spoornet SPAD Investigation
9642	H Hadorn	The SBB rescue - train management system
9643	D Byrne	An overview of Rail Safety in Australia

Attachment A, (Part 8)

1997 LUCERNE

21 May - 23 May 1997
Swiss Transport Museum, Lucerne, Switzerland

INDEX

Folder	Author	Paper
9701	P.A. Urech	Welcoming Address
9702		List of Delegates
9703		Conference Programme
9704	W. Kaeslin	Safety at Work - A new approach in Safety Management
9705	S.S. J. Robertson	Work on the Track
9706	O. Mornell	Reducing Human Errors at Level Crossings in Sweden
9707	G. Churchill	Human Reliability in the Safety Related Jobs at RATP
9708	Y. Yuzuki M. Takahashi	Safety Management-Union's Challenge to Safety for these 10 yrs.
9709	O. Cremien	Consideration of Traumatic Factors and their treatment in Jobs involving Safety-related tasks
9710	J. Hendriks	Learning from Incidents: Control the Controllable
9711	S. Nakai	Crisis Management in the EJRC-Taking the example of a major earthquake
9712	J.B. Benech	Safety Arrangements for crossing rail tracks
9713	S.S.J. Robertson	Vandalism-Management of a Social Problem
9714	P. Godier	Case Study-Suicides on London Underground
9715	J. de Villiers	The principles of safe movement on rail (POSMOR) and Safety

		Management for the Future
9716	Dr C Lienert	Risk Scenery at Swiss Railways
9717	T. Persson	Banverket-Experiences of decentralised maintenance machine ownership
9718	T Aikawa	Cost-Effective Measures against Signal Overrun Accidents
9719	D Davies	Tranz Rails's Alertness Management Programme
9720	J Stuifmeel	Case Study-Safety Philosophy New Freight Line
9721	H Bruwer	The social impact of the Transportation of Dangerous Goods by Railway
9722	H R Lehmann	Safety Management and ISO-Certification
9723	B Keen G Arkwright	Risk based Safety Management
9724	Wong Woh Sung	Escalator Injuries in Railways
9725	Mrs D. Mabale	Risk Management-Involving Trade Unions in SHE (Safety, Health, Environment) Principles of a SHE Forum
9726	W.S Casley	Rail Safety Regulation Down Under
9727	U Palsson	Harmonisation of Traffic Safety Rules in Scandinavia

Attachment A, (Part 9)

1998 SYDNEY

26 August - 28 August 1998
Hotel Nikko, Darling Harbour, Sydney, Australia

INDEX

Folder	Author	Paper
9801		List of Delegates
9802		Conference Programme
9803	K. Band'	Medical Fitness Standards for Train Crews
9804	J. de Villiers	Developing a Railway Policy on Substance Abuse
9805	J. T. Atkinson	The role of the Regulator in Rail Transport Safety: The "stand-back" Approach
9806	Mrs F Ackermans	Towards Performance Based Regulations for Rail Operations
9807	M. Yamano	Human Factor in Safety Control
9808	Ms C.. Lindahl	Human Computer Interaction in Design of New Traffic Control Systems
9809	K. Sekine	Bureaucracy of organisation result in operational faults and fatal accident to track worker
9810	R. E. Howe	Independent Rail Occurrence Investigation - A New Zealand Perspective
9811	C. Hall	The Management of Contractors in a Privatised Railway System
9812	H. Ring	Management and Safety Auditing in Sweden
9813	A. Olofsson	Swedish Experience in Rail Policy Developments in Sweden since 1988
9814	W. Fowler	Railway Infrastructure Safety
9815	H. Ring	Do We Need an International System (ISP Standard) for Safety

9816	J de Villiers	A Risk Profile of the Heavyhaul Ore Export Line
9817	T Hatton	Safety Standards-Harmonisation or Uniformity?
9818	Dr M Maynard	A Probabilistic Approach to QRA - London Underground's Experience
9819	Dr J Kam S. Lee	Operational Safety Management for New Lines through System Assurance Approach
9820	Dr G Booysen	Safety Standards and Insurance Requirements-A Case Study of a Freight Protection Facility
9821	M Holt	Risk Measurement and Risk Management
9822	T Aikawa Y Omagari	Obstacle Detection for Shinkansen Track Using Image Processing
9823	W. Tucker	Canada's Approach to Rail Accident/Incident Investigation - A Case Study
9824	A. Sit	Crowd Management Plans in MTR - Hong Kong
9825	G. Churchill	The Safety Case on the New, Entirely Automated Paris Subway Line Meteor
9826	K Kawano N. Akatsu	The Development of a New System of ensuring Safety at Maintenance Work
9827	W Tucker	Accident Investigations-What Should They be Looking For?
9828	V Coleman	Standards-In the Service of Safety
9829	T Burch	Canada's Future Rail Safety Framework
9830	J Joyce	Setting up and Maintaining an Operation under the Rail Safe Accreditation
9831	D Davis	Safety Through Customer Service Training Programme
9832	S S J Robertson	Achieving Safety on the Railway
9833	A. Bester B A. Carver	Safety Standards in Training of Train Drivers for Metrorail

Attachment A, (Part 10)

1999 BANFF

19 October - 22 October 1999
Banff Springs Hotel, Banff National Park, Alberta, Canada

INDEX

9916	M. Mathebula	Linking Employee Engagement to Safety Performance: A Human Assets Approach
9917	M Papst	Psychological Aspects of Rail Safety
9918	K Chiba K Tsuru	Promotion of Spread of Union's Safety Philosophy
9919	T Secord A Ferrusi	Joint Initiatives in Health and Safety
9920	A. Ferrusi T Burtch G. Hucker	Plenary Session "B" - The Influence of Human Reliability in Safety Performance
9921	D Edwards	Rail Safety Worker Training, Assessment and Compliance - An Australian Perspective
9922	G. Housch	Railway Culture Breaking the Mold
9923	J Hall	Change the People or Change the People!
9924	A. Ryokawa T. Matsuda	Evaluation of Safety Activities and Identification of Future Safety Policies Based on the Questionnaire Research to Employees
9925	D Davis	A Review of Locomotive Engineers Extended Hours of Service
9926	Y. Toyoshima M Takahashi	Lessons from a Fatal Accident to Subcontracted Workers on Yamate Freight Line
9927	E McCullough R Gnam	The Safety Investigator - The TSB Approach to Accident Investigation
9928	M. Walter	Improving Accident Investigation on the UK's Privatised National Railway
9929	R. Howe	Rail Accident Investigation - Messages for the Millennium
9930	J. de Villiers R. Howe	Plenary Session "C" - Incident Notification - Cooperate or Regulate
9931	G E. Lower	Aspects of Stabilising and Developing Safety in a Railway System, An Enhanced Approach to Railway Safety
9932	Dr. J. Kam I. Lai	Safety Assurance for New Extension Projects of the Hong Kong MTR Corporation

9933	F. de Jouvencel	Risk Management as Applied to the Carriage of Dangerous Goods on SNCF
9934	H Ring	Managing Safety Cost Models
9935	G A. Smallwood	Managing Safety in Mergers and Divestitures
9936	C. Erasmus R. Matshoge	Safety Standards for Training of Train Drivers in Metrorail
9937	A. Pretorius	Towards Safe Norms in Train Control Systems
9938	F.K. Turner	Some Things Never Change
9939	F Ackermans	CPR - Safety Management Process

ATTACHMENT B

INTERNATIONAL RAIL SAFETY CONFERENCES, 1990 - 1999

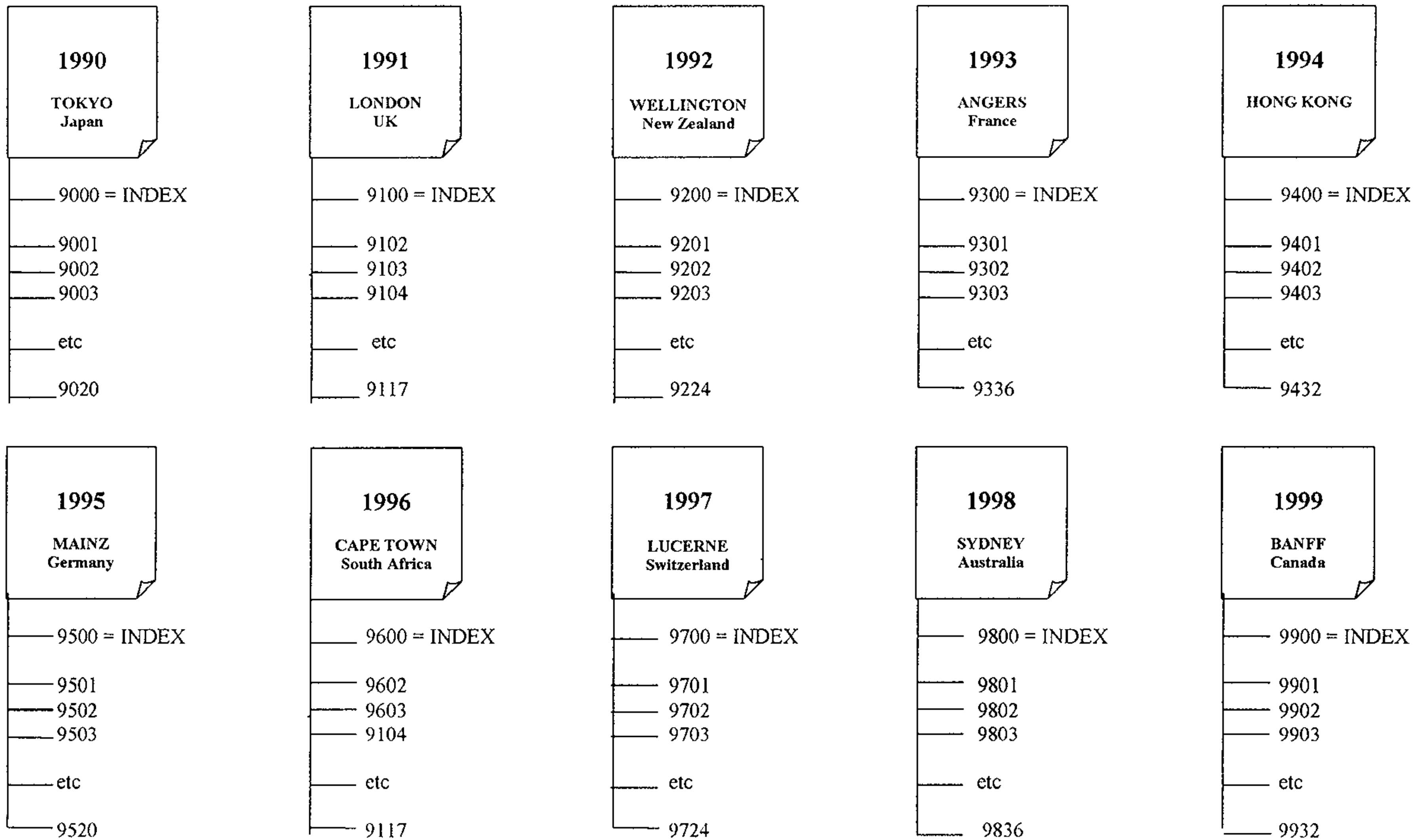
REFERENCE MATRIX
COUNTRY - ORGANISATION - PAPERS

Country	Organisation(s)	Paper Reference Nos.
AUSTRALIA	ANR	9216, 9220
	BCC	9911
	FreightCorp	9821
	Mpapst	9917
	NRC	9921
	NSWDOT	9335, 9422, 9529, 9530, 9726, 9801, 9802, 9814, 9923
	NSWRAC	9817
	NSWSRA	9011, 9104, 9209
	QR	9105, 9420, 9803
	TNT	9830
	VICDOI	9643
	VICPTC	9336, 9430
CANADA	BMWE	9922
	CN	9319, 9329, 9506, 9919
	CPR	9806
	Transport Canada	9829, 9901, 9902, 9903, 9905, 9920
	TSB	9823, 9827, 9927
CHINA	China's Rlys (CR)	9015
FRANCE	INRETS	9004
	RATP	9320, 9324, 9416, 9520, 9612, 9707, 9825, 9914
	SNCF	9005, 9102, 9110, 9111, 9203, 9208, 9218, 9221, 9301, 9302, 9303, 9304, 9305, 9315, 9316, 9327, 9331, 9410, 9414, 9509, 9511, 9640, 9709, 9712, 9933
GERMANY	DB	9007, 9108, 9204, 9333, 9429, 9501, 9502, 9519, 9637, 9931
HONG KONG	CIOR(HK)	9418
	KCR	9421, 9425, 9639
	MTRC	9325, 9401, 9402, 9409, 9415, 9423, 9428, 9512, 9518, 9521, 9525, 9527, 9616, 9633, 9636, 9819, 9824, 9932
HUNGARY	MAV	9020
IRELAND	DPE	9904
JAPAN	East Japan Rly Co	9001, 9002, 9008, 9009, 9010, 9016, 9017, 9018, 9019, 9207, 9217, 9219, 9306, 9309, 9321, 9326, 9404, 9419,

JAPAN Contd.		9424, 9427, 9513, 9516, 9522, 9531, 9619, 9620, 9621, 9622, 9708, 9711, 9718, 9807, 9809, 9822, 9826, 9910, 9918, 9924, 9926,
NETHERLANDS	NS	9006
	NV	9311, 9312, 9332
	RailNed	9505, 9624, 9628, 9710, 9720,
NEW ZEALAND	LTSA	9805, 9006
	NZRC	9013
	NZRL	9106, 9112, 9113, 9115, 9116, 9201, 9202, 9205, 9212, 9213, 9224, 9307, 9432, 9528
	TAIC	9810, 9929, 9930
	Tranzrail	9630, 9719, 9831, 9925
SINGAPORE	MRT	9611, 9615, 9724
SOUTH AFRICA	MetroRail	9604, 9606, 9626, 9638, 9833, 9908, 9936
	TransNamib Ltd	9610, 9623
	Transnet	9210, 9310
	Spoornet	9411, 9431, 9524, 9607, 9614, 9618, 9625, 9629, 9635, 9641, 9715, 9721, 9725, 9804, 9816, 9820, 9907, 9916, 9930, 9937
	Swaziland Rlys	9617
SWEDEN	Banverket	9613, 9627, 9706, 9717, 9808, 9812, 9813, 9815, 9912, 9934
	SJ	9532, 9605, 9727
SWITZERLAND	SBB	9514, 9517, 9642, 9701, 9702, 9703, 9704, 9716, 9722
UNITED KINGDOM	BRB	9014, 9101, 9103, 9107, 9109, 9114, 9117, 9206, 9211, 9222, 9308, 9314, 9317, 9318, 9322, 9327, 9328, 9330, 9334, 9407, 9507, 9510, 9609, 9634
	Eurotunnel	9405
	HSE	9608, 9705, 9713, 9828, 9832, 9908, 9909
	LUL	9214, 9215, 9223, 9313, 9408, 9426, 9504, 9631, 9632, 9714, 9818, 9913
	Railtrack	9403, 9406, 9412, 9413, 9417, 9503, 9508, 9515, 9526, 9601, 9602, 9603, 9723, 9811, 9928,
USA	AMTRAK	9012
	ASLRRA	9938
	BNSF	9935
	CSX	9915

ATTACHMENT C

CD PROJECT - PROPOSED FORMAT



ATTACHMENT D

ORDER SURVEY FORM

CD PROJECT Team
PO Box 71
SUTHERLAND NSW 2232
AUSTRALIA

YES, Please register my order for ☐ copy/copies of the CD containing the 1990 to 1999 Rail Safety Conference Papers.

I understand that the supply of the CD is the outcome of a co-operative non-profit exercise for members of the International Rail Safety Conference only.

I further understand that as at November 2000 it is not possible to determine the actual cost of the CD until firm production quantities have been established.

I note that upon determination of the cost to supply the CD, advice will be forwarded to me. However, delivery arrangements will not be instituted until the necessary payment (Australian Dollars) has been finalised.

PLEASE PRINT

Name:..

Address: Street...

City...

Country...Code.......................

Signed:...

Telephone:...

Facsimile:...

E-mail:...

Office use only

Costs advised	Payment received	CD despatched

ATTACHMENT E

PROPOSAL

FOR THE FACILITATION OF THE ARCHIVING OF CONFERENCE PAPERS

INTERNATIONAL RAIL SAFETY CONFERENCES, 1990 - 1999 CD PROJECT

Project Objectives
The project is designed to facilitate the archiving of conference papers from former conferences. In this regard the objective of the project is to locate all the previous papers, collate them into a suitable electronic format (CD) and, to produce and supply copies of the CD for the exclusive benefit of delegates of past and future conferences

Costs
The project is to be conducted as a non-profit cooperative exercise

CD Project Team
The Conference endorses the following members as the CD Project Team.

Bill Casley, (BILL CASLEY CONSULTANTS PTY LTD)
John Hall, (EXEC DIRECTOR, NSW TRANSPORT SAFETY BUREAU)

The Project Team members may co-opt other members of the conference onto the Project Team to assist as required.

Liability of CD Project Team
The CD Project Team shall execute their responsibilities to the best of their abilities, with all due care and attention Membership of the CD Project is clearly on the basis that no responsibility is accepted or implied by the members of the CD Project Team in relation to any matter arising from any actions, claims, costs, expenses and damages (including legal costs) associated with the CD Project

Supply and Distribution
The CD Project Team is endorsed only to supply copies of the CD to those members of the conference who have presented papers at an International Rail Safety Conference

Report
The project team shall provide delegates to the 2001 Conference with a final report regarding the outcome of the project

International Rail Safety Conference

2000 LONDON

8 November - 10 November 2000
Forum Hotel, London, United Kingdom

Paper 0034

Bill Casley

Third Plenary Session

How Safe is Safe?

Note: This paper formed the keynote discussion paper for the Third Plenary Session. As the session was conducted as an interactive verbal discussion, no written paper is available of the outcome of these discussions.

Publisher
2000 International Rail Safety Conference

International Rail Safety Conference

Bill Casley

Director

Bill Casley Consultants Pty Ltd, Australia

Plenary Session:

How Safe is Safe?

**Paper for presentation at the Eleventh International Rail Safety Conference,
London, Great Britain
8-10 November 2000**

"HOW SAFE IS SAFE"?

**A DISCUSSION PAPER FOR
THE THIRD PLENARY SESSION
OF
THE ELEVENTH INTERNATIONAL RAIL SAFETY CONFERENCE,**

W. S. Casley

THE THIRD PLENARY SESSION
OF
THE ELEVENTH INTERNATIONAL RAIL SAFETY CONFERENC

1. Introduction

Since the first passenger train commenced operation in 1830 until the present day, there have existed a variety of opinions as to what constitutes a safe railway

For the past decades it has become commonly accepted there is a universal public expectation that railway operations and activities, as distinct to other transport mode activities and operations, should be conducted in a safe environment without delay In this regard incidents, which delay the travelling rail public, are not accepted in the same sense than that accepted in connection with air travel or for that matter road travel

Similarly delegates will no doubt be able to provide examples where differences of opinion exist not only between the travelling public and the rail operators, but also between the rail industry and its regulators.

Consequently, amongst the major challenges facing the railway industry, regulatory agencies and the general public is the challenge of ensuring each party has a consistent interpretation of those elements, which constitute safe railway activities and operations

This may not be as simple as one may think, as it would appear there is not a clear definition as to what does the word "safe" mean in the current environment of rail travel This apparent "confusion" is not confined to the travelling public and the rail industry It is interesting to note that even the world's lexicographers do not appear to have a consistent and concise meaning of the word "Safe" Some examples of these interpretations are shown in Attachment A

2. Purpose of Paper

The purpose of this Plenary Session Paper is to provide the stimulus for an opportunity for delegates to discuss and where practical establish the essential elements for a consistent and concise definition of the word "safe", when used in a railway context

3. Issues

In order to determine a consistent and concise meaning of the word "Safe" when used in a railway context, the delegate's attention is directed to the following issues

It should be noted, these issues are not intended to be an exhaustive list of safety considerations nor do they appear in any precise order of priority. The intent being to provide an overview of likely issues that delegates may wish to consider when attempting to resolve **"How Safe is Safe".**

This may not be as simple as one may think, as it would appear there is not a clear definition as to what does the word "safe" mean in the current environment of rail travel. This apparent "confusion" is not confined to either the travelling public or the rail industry. It is interesting to note that even the world's lexicographers do not appear to have a consistent and concise meaning of the word "Safe". Some examples of these interpretations are shown in Attachment A.

3.1 What constitutes a safe railway?

A "safe railway" should be able to readily demonstrate its ability to control the processes that determine the acceptability of its railway safety activities. Generally the railway can demonstrate this by the following:

- **Resources and facilities are adequate for the railway's activities.**
  - Workers competence, qualifications, and fitness for their railway safety work is not questionable,
  - Workers conducting railway safety work have the necessary sense of responsibility, physical and mental fitness and necessary capacity to perform their safety tasks.
  - The integrity of the Infrastructure is maintained and capable of performing its allotted task.
  - The integrity of the Rolling Stock is maintained and that it is compatible with the track and other infrastructure parameters.
  - Train integrity is maintained before and during its journey,
  - Train routes are safe to operate over.

- **It is safe for people using and working on the railway,**
  - Stations to provide secure and safe access and egress to and from trains,
  - Track crossings for people to be adequate,
  - Trains to provide acceptable access, egress and means of travel for people,
  - Working environment for staff to be acceptable.

- **The railway is safely operated and controlled,**
  - Acceptable interfaces between the control of infrastructure, trains stations and emergency services,
  - Effective communication systems
  - Trains have adequate safe routing, spacing and control of train separation,
  - Effective facilities to deal with normal, abnormal, degraded and emergency situations

- **The railway is adequately protected from unauthorised interference.**
  - Effective control against unwanted intrusion and unauthorised access,
  - Effective provision of barriers and signs,
  - Effective control from activities adjacent to the railway

3.2 How should the industry demonstrate its achievements in respect of the safety of its railway activities and operations?

- **What should or needs to be made available?**
  - Operational safety statistics
  - General performance statistics
  - Accident outcome reports
  - Safety improvements regarding infrastructure, rolling stock or operational matters

- **To whom is it released?**
  - Public generally
  - Selected members of the Public
  - On a needs to know basis only
  - Railway workers only

- **Regularity of announcements**
  - Is the release of too much information advantageous?
  - What constitutes too much?
  - When and how often?

- **What format**
  - Press release
  - Public advertisement
  - Printed media
  - Internet

- **Feedback**
  - Is it necessary?
  - If so, how is it managed?

3.3 How may the general public demonstrate in a meaningful way its legitimate concern regarding safe rail activities and operations?

- Railway Customer Relations Office
  - Well published access detail (Postal, Phone etc)
  - Dedicated telephone lines
  - Dedicated facsimile lines
  - Dedicated E-mail addresses

- Regulator's Office

- Ombudsman's Office (where available)

- Print or television media

- Investigative media journalism

3.4 Is it reasonable for the general public to equate any delay and its associated inconvenience to the public's travel arrangements, as a measure of the railway's safety or lack of it?

If so, how should this be measured?

3.5 It is a sufficient defence for the railway industry to claim that it has a safe operation by comparing say a lower rate of fatalities per million kms of passenger travel (or similar measure) to that of another mode of transport?

- Internal Rail Industry comparison
  - Country vs Country (eg. Australia vs UK),
  - Company vs company within same operating environment
- Rail Industry vs Airlines Industry
- Rail Industry vs Road Industry
- Rail Industry vs comparison of all transport modes (Air, Road, Sea)

3.6 What is the measure of consistency that exists throughout the Railway Industry

- What measure exists within individual countries
  - Rate of fatalities per million kms of passenger carried
  - Rate of fatalities per million passenger journeys
  - Rate of fatalities per million train kms travelled
  - etc

3.7 What are the respective delegates' views for defining "How safe is safe"?

- The delegates are invited to discuss this matter with the view of establishing **"How safe is safe"?**

ATTACHMENT A

EXAMPLES OF THE DEFINITION OF THE WORDS "SAFE" & "SAFETY"

The following sets out a range of published definitions of the words "safe" and "safety" It should be noted they are not intended to be neither an exhaustive list of published interpretations nor do they appear in any precise order of priority The intent is to provide the reader with a chronological insight into the variety of interpretations that can exist in the various dictionaries published throughout the world. Readers will no doubt be aware of other examples

Cassell's New English Dictionary, 1936

Safe

Adjective: Free or secure from danger, damage, or evil, uninjured, unharmed, sound; affording security; not dangerous, hazardous, or risky; cautious, prudent, trusty, unfailing, certain, sure; no longer dangerous, secure from escape or from doing harm

Noun: A receptacle for keeping things safe, a strong box, a cupboard for keeping meat and other provisions in.

Safety

Noun: The state of being safe, freedom from injury, danger or risk.

Webster Universal Dictionary, 1968
International Edition

Safe

Adjective: **1.** Free from danger, not liable or exposed to risk or danger, protected, sheltered secure *[to be safe from attack]* **2.** Freed from, escaped from, out of danger, having escaped damage, injury &c; uninjured, unharmed, in good, sound condition: *[to bring something back safe; the ship is now safe in the harbour]* **3.** Affording security, protection, shelter, secure against danger, injury &c: *[a safe place to live in; a safe anchorage]* **4a.** Not likely to be the cause of danger or disaster; involving no risk: *[is it safe to travel so fast?; the bridge is now safe for traffic]* **4b.** free from error, secured against risk of making mistakes; unlikely to be erroneous *[you are perfectly safe in believing what he tells you; it is safe to bet on what is certain]* **5a.** Securely confined, unable to break out, prevented from inflicting injury &c.. *[safe in goal]* **5b.** incapable of being broken through, escaped from· [in safe custody] **6a** (of persons) Cautious, prudent, not taking rash risks, not reckless, inspiring confidence *[a very safe surgeon to consult; my chauffeur is a very safe driver]* **6b.** (in unfavourable sense) possessing foregoing qualities to an exaggerated degree; hence, unenterprising, afraid to take any risk; taking always a conventional course; timid in action. *[it is often the safe men who get the important posts]* **7a.** Morally reliable, discreet; trustworthy, faithful to a trust or obligation: *[a perfectly safe person to confide in]* **7b** certain to be faithfully kept; inviolate: *[your secret will be safe with me]* **8a.** Likely or certain to occur; *[it is safe to get warmer as the day goes on]* **8b** certain to do something, or to undergo something: *[the favourite is safe to win]*

Noun: **1.** A specially strong receptacle, often made of steel and built into a wall, for keeping valuables of any kind. **2.** A receptacle, cooled and ventilated, for storing food.

Safety

Noun: quality, state, of being safe (in various senses of adjective)

Rogerts Thesaurus, 1987

Safe

Adjective: **1.** secure, impregnable, immune, protected, unendangered, rescued, guarded, snug. **2.** unhurt, unscathed, intact, alive, unharmed, undamaged, whole, sound, saved. **3.** reliable, certain, sure, dependable, secure, trustworthy, tried and true, conservative.

Safety

Noun: security, protection, safeness, preservation, safekeeping, shelter, asylum, refuge, surety, immunity, custody, sanctuary.

The Macquarie Encyclopedia Dictionary 1990 (The National Dictionary of Australia)

Safe

Adjective: **1.** Secure from liability to harm, injury, danger or risk. **2.** Free from hurt, injury, danger, or risk: *[to arrive safe and sound].* **3.** Involving no risk of mishap, error, etc: *[a safe estimate]*. **4.** Dependable or trustworthy: *[a safe guide]*. **5.** cautious in avoiding danger: *[a safe player].* **6.** Placed beyond the power of doing harm; in secure custody: *[a criminal safe in goal].*

Noun: a steel box or iron box or repository for money, jewels, papers etc. any receptacle or structure for the storage or preservation of articles: *[a meat safe].*

Safety

Noun: 1. The state of being safe; freedom from injury or danger. 2. The quality of insuring against hurt, injury, danger, or risk.

The Australian Oxford Dictionary, 1999

Safe

Adjective: **1a.** free of danger or injury. **1b.** out of or not exposed to danger. **2.** affording security or not involving danger or risk. **3.** reliable, certain, that can be reckoned on **4.** prevented from escaping or doing harm. **5.** uninjured, with no harm done. **6.** cautious and unenterprising; consistently moderate.

Safety

Noun: The condition of being safe, freedom from danger or risks

International Rail Safety Conference

2000 LONDON

8 November - 10 November 2000
Forum Hotel, London, United Kingdom

Paper 0035

Mabila Mathebula

Challenging Old Paradigms: New Roles for Railway Safety Managers

Publisher
2000 International Rail Safety Conference

CHALLENGING OLD PARADIGMS:

New roles for Rail Safety Managers

M MATHEBULA

Rail and Terminal Services, Spoornet Head Office, South Africa
P.O. Box 2772, Joubert Park, Braamfontein, 2044

ABSTRACT

This paper attempts to highlight new roles for Rail Safety Managers for the year 2000 and beyond. The last century was highly characterised by a number of rail related accidents. This was not only confined to the South African Rail Industry, but it was continental and global in scope If this situation goes unbridled, more workers would still be injured, liabilities would grow, assets would be destroyed and profits would decline. This century would require a change of gear – scenario on the part of Rail Safety Managers During his inaugural address, President Bill Clinton said, "to renew America; we must be bold We must do what no generation had to do before. We must invest more in our people and in our future " To improve rail safety we must be bold as well. We must challenge the old paradigms of management and create room for new paradigms. In Spoornet, we have identified ten roles for Safety Managers, which are matched with a number of competencies. Once Safety Managers master these roles and competencies, safety would be our core competence. A core competence is built on knowledge and expertise

CURRICULUM VITAE

This serves to introduce Mabila Mathebula. He holds the following qualifications: BA (Vista), BA Hons in Sociology (Unisa) MBA (Thames Valley University-UK) and a Post Graduate Advanced Diploma in Project Management (College of Project Management). He started his career as a teacher at Pace Community College (1988-1993) where he headed the department of accounting. He joined the SABC (1993-1994) as a News Producer 1995 saw him coming to Spoornet to head the Internal Communications function. He moved to Safety Management in I997. He visited the following countries to benchmark safety with different railways USA, Canada, Australia and New Zealand. He presented a number of papers nationally and internationally on safety management". He developed a safety pyramid for safety management. He also developed a programme on multicultural management. He is happily married to Joy He enjoys writing, lecturing strategic management on part-time basis as well as motivational speaking. Although he is committed to academic excellence, he also extends himself extramurally.

CHALLENGING OLD PARADIGMS:

New roles for Rail Safety Managers

M MATHEBULA

Rail and Terminal Services, Spoornet Head Office, South Africa
P O. Box 2772, Joubert Park, Braamfontein, 2044

INTRODUCTION

Mark Twain once observed about the medical profession that because the only requirements for practicing medicine were ignorance and confidence, nearly anyone could do it. We cannot afford to manage safety through ignorance; this is the era of confidence and competence Ignorance and safety cannot co-exist Unfortunately, ignorance has been a dominant feature among a number of safety managers.

It would be difficult to understand railway safety without understanding railway history. In other words, if you want to understand history you must look at the bigger picture (not people or things). For example, if you want to understand the history of Germany, don't look at Hitler, but you should look at white supremacy If you want to understand African history, look at slavery

The advent of railroads in the 1820s was a "killer application" (Downer and Mui, 1998). A killer application is one that alters the way society functions. With railroads, people could travel only between fixed points on the same track, based on a dictated timetable. The fixed plans, fixed rail, fixed stations and the fixed time schedule created a fixed mindset among railway employees and management Rubinstein and Firstenberg (1999) observed that railroads created a monolithic organisation, with no room for maneuverability. Today we must be mindful of the fact that the value is shifting from trains to integrated logistics. This calls for our paradigms to change, but old habits die-hard!

The primitive railway placed more emphasis on utility rather than safety In the beginning wagons were drawn by horses and safety was not an issue. With the advent of steam locomotives in the 1830s which resulted in increased speed and weight of trains, safety became an important element (Shaw, 1978)

In the past, we must admit, that safety endevours have lagged considerably behind, the emphasis was only on speed and power Who has to change, safety or safety managers? Safety would never improve if people do not change. We really have to change our paradigms

Deming threw down the gauntlet to all safety managers "Management must feel the pain and dissatisfaction with past performance and must have the courage to change. They must break out of line, even to the point of exile among their peers. There must be a burning desire to transform their style of management" (Dennis, 1997).

It is axiomatic that safety management is in a crisis. Why do organisations choose to perish rather than taking heed of Deming's challenge? Firstly these organisations cannot learn and because of their none learning ethic they are learning disabled Secondly, suffer from what (Sheedy et al, 1996) call "paradigm paralysis", their central nervous system has been damaged.

Railway safety suffered a great deal because of a Newtonian mindset. Newton believed that the world was mechanistic and limited (Korten, 1999). All our organisational structures were based on this theory The railroads in particular were founded on the Newtonian theory (everything was fixed), no one was allowed to step across the line Everything was confined to the box, safety was no exception It is cheering to note that the world is not mechanistic, it is an infinite set of possibilities (the world is limitless) This was further enhanced by astronomer, James Jeans, "The universe begins to look more like a giant thought than like a great machine"(Sheehy, 1996).

It is important to note that safety is not a new management responsibility The code of laws of the king if Babylon king Hammarabi (Circa 220 BC) prescribed punishment of overseers for injuries suffered by workers The first five books of Moses in the Old Testament also contain safety laws (Dennis, 1997)

Why do we still use ancient methods to manage safety? Our paradigms have not yet changed. If we change our paradigms, safety will also improve. To achieve this, we need safety managers with Emotional Intelligence (Mathebula, 1999).

1950'S MENTAL MODEL FOR BUSINESS

Science has a profound impact on how we construct our world. As a result we shape and direct our organisations according to the science of our time. Inherent in the old mental models are three mechanistic metaphors: universe as clock, brain as computer, and learning as tabula rasa (blank slate).

In the 1950's workers were not expected to disrupt stability, the workforce was highly controlled The events were not reasoned and messages were also managed. One way top down communication was the name of the game People were deeply engrossed in activities, not in processes and strategies. In addition, the pyramid structure was commonplace followed by the box approach

Troubleshooting became a norm; end-of-the-pipe thinking involved an emphasis on accident investigation. This type of mindset also entailed an emphasis on regulatory compliance More resources were expended on accident investigation and not on accident prevention. Those who violated the rules were severely punished by management.

Dennis(1997) observed that increased supervision and heavy discipline do not improve safety at all. Coercive power cannot improve safety performance. Our paradigm has to shift from a machine-based "clockwork" conception of the universe to a complex adaptive system perspective The employment of the systems approach is vital in reducing entropy in safety management.

The fixed railway mindset chimed well in the 1950's. Our major problem today in the railway is value shift The value has shifted from trains, trucks, and planes to Integrated Logistic. The mental models of the 1950's no longer hold water. The value shift in the railway industry compels us to look at safety from a new perspective. The fixed railway mentality is not a solution to our problems. Workers are injured, liabilities grow, assets are destroyed, and the morale is at low ebb and profits decline. This situation warrants the attention of all rail safety managers

We are at the cusp of a new era We can no longer afford to employ a fixed mind in a flexible world. The clockwork organisation does not address safety We definitely need a change of paradigm. The universe definitely looks like a giant thought not like giant clock. Safety managers must realize that the emperor has no clothes, many safety leaders today are ignoring the fact that the organizational system they represent is no longer functional.

MENTAL MODEL FOR BUSINESS IN THE NEW MILLENNIUM

Let me borrow language from Peter Drucker "The organization is, however, more than a machine, as it is in Fayol's structure It is more economic, defined by results in the marketplace The organization is, above all, *social.* It is people Its purpose must therefore be to make the strengths of people effective and their weaknesses irrelevant" (Drucker, 1996)

The organizations of this millennium are simply described as "virtual"; you can describe what they do but cannot see them. The safety manager should understand the dynamics of managing in this new age. The workforce has changed completely (workers' rights are now a priority). The priorities for this new age are the following: speed of response, quality, continuous big changes, and battle for market share, multicultural management, participative management and globalization

This millennium would call for a multiviewpoint and multidisciplinary approach on the part of rail safety professionals

TABLE 1

MENTAL MODEL FOR CHANGE AT SPOORNET:	
Domestic South African company	**World Class Global Company**
Competition	**New entrants into the market**
Quality as a Product	**Quality as a way of managing**
Portfolio of Separate Strategies	**Integrated business strategies**
Comparing ourselves to ourselves	**International benchmarking**
Customer as end point	**Customer as boss**
Order driven	**Value Driven**
Compensation- reward for all	**Performance related pay**

Spoornet Industry program (`1996)

CREDIBILITY AS A FOUNDATION

Mathebula argued (1999) that safety is undermanaged and underled While we have argued that much has changed in organisations, it is important to note that in creating a new management paradigm, there are some key principles which remain unchanged. James Kouzes and Barry Poster (1995) researched characteristics that employees most admire about their leaders. Since the early 1980 the top four characteristics have not changed. These characteristics are **honesty, forward-looking, inspiring and competency** They refer to these four qualities as *credibility*.

Smith and Kelly (1997) argue that leadership is based on six dimensions. conviction, character, care, courage, composure, and competence It was William Chiat (1998) who once wrote "Therefore, we believe credibility is a characteristic, which underlies all aspects of the role and competencies of an effective manager. Unless one can establish credibility with their employees, the rest of the discussion is meaningless"

More often than not, managers misinterpret competency as the ability to do the job of each person they supervise. Competency refers to the manager`s ability to manage as a capable and effective leader. "Functional competence" argue Kouzes and Posner may be necessary but insufficient; the leader is also expected to bring added value to the position . "Expertise in leadership skills. the ability to challenge, inspire, enable, model and encourage must be demonstrated as well, if leaders are to be seen as capable". For this reason, understanding and integrating the roles and competencies of a safety manager are critical issues to their effectiveness and the success of the organisation.

ROLES OF RAIL SAFETY MANAGERS

Sociologists say that he who occupies a status must also play the role What is the role of a rail safety manager? A number of people would say the role of a manager is to ***plan, organize, coordinate, and control***. It is very difficult to put these four functions into practice. Mintzeberg (1998) noted that the four words once introduced by Henri Fayol tell us little about the role of a manager. A number of managers start off by carving out a wrong plan. They go on organizing this faulty plan They also take infinite pains to coordinate the plan and then take control over an erroneous plan Safety managers do not have to be trapped into the four words. The role of a rail safety manager goes beyond the four traditional roles If rail safety managers confine themselves to this four-cornered box, safety performance would not improve. Rail safety managers must step across the line for the common good of safety

1. COMMUNICATOR ROLE

Communication is good business. Communication is essential for creating a safe working environment. We live in an ever-changing environment in which communication is vital Communication eases the pain of change. Information hoarding by management is indeed a thorny issue In a number of organizations there is a strong undercurrent of anger, frustration and resentment directed toward invisible management. The wellspring of safety performance comes through the disclosure of information to employees Our South African managers think of power in zero-sum ways. If they have power, others do not. If others do, they don't. A number of them think that information hoarding enhances oneself and diminishes those who do not have the information. This era calls for safety managers to disseminate information as soon as possible to their employees Most managers forget that this is the information age. Employees have a right to receive information on time. For example, if there is a collision or a derailment it is up to the manager to communicate to all his employees Imagine what could happen if the weather bureau could decide to hoard the weather details from the public. People would be soaked in the rain, they may suffer from oppressive heat or they may catch pneumonia. Why should the bureau keep the public informed about the weather? So that we can wrap up warmly or bundle up. Workplace values today parallel societal values. People expect democracy in the workplace in the form of a stimulating working environment and transparency. Rail safety managers cannot operate on a hit or miss basis in our ever-changing environment. They have to enact the role of a communicator. Communication is the glue that holds an organization together.

2. ENERGIZER ROLE

People make safety possible. The rail safety managers should be excellently equipped in energizing their employees. Rail safety managers must be "high touch" with their employees during this "high tech" era. People do not perform well when they are not motivated. Managers must create a supportive and a safety work environment to foster desired behaviors and outcomes. Employees should be given the authority to make decisions. Employees should also be allowed to make mistakes because mistakes are part of the learning curve.

Pepsi CEO Wayne Calloway said that his company had celebrated occasions were people failed publicly. His argument was that he wanted them to take risks (Farkas et al, 1995). Rubinstein and Firstenberg (1999) in their book, *The Minding Organization* encourage people to learn from errors. "Experience" they write, "is not only to know what will work...but also to know what will not work. Railway safety has always been characterized with the box approach Policies and procedures that fail to energize employees must be replaced with simple versions (Nelson, 1997).

3. PREVENTIVE ROLE

It is a known fact that "prevention is better than cure" We should move from accident investigation to accident prevention Accidents must be proactively prevented. Huge efforts are expended to investigate accidents. The role of a safety manager must be a preventative one. Resources are being wasted to investigate accidents. These resources should be directed towards the prevention of accidents The paradigm must shift from investigation to prevention. Dennis (1997) stated that traditional safety management tends to be reactive, not proactive. Reactivity does not improve safety performance

4. COUNSELLOR ROLE

The counseling role is of overpowering importance in safety management. The heroes of the future would be those who would be enacting the counseling role, devotedly and concernedly. The manager should know whether an employee needs counseling or coaching It would be mistaken and shortsighted to coach an employee who does not need couching or to counsel one who needs coaching. A leader provides counseling when he realizes that a follower understands exactly what needs to be done and how it needs to be done, but does not act Rail safety mangers must consistently monitor their employees. Confusing the two roles could frustrate an individual or leader (Dickens and Dickens, 1991).

5. COACH ROLE

Rail safety managers should understand knowledge management. Knowledge management is lacking among a number of safety managers A number of incidents happen due to the lack of knowledge on the part of the employees. A leader provides coaching when employees need to do something but does not know how to accomplish the task at hand (Dickens and Dickens, 1991). The safety manager should be in a position to draw a line of separation between counseling and couching. Rail safety managers need to coach their employees for the collective good of safety performance.

6. DISCIPLINARY ROLE

When sin began, retribution set in. Disciplinary measures should be taken when employees do not conform to safety requirements There is a lot of literature on the elimination of the hierarchy in favor of the all channel network organization The hierarchy is associated with rigid rules and procedures On the other side of the coin, we must strike a balance between a hierarchy and the network. Rubinstein and Firstenberg (1999) maintain that we need both hierarchies and networks They further argue that networks are prevalent in new organizations, on the other hand, it is interesting to note that hierarchies are prevalent and useful when ideas are to be implemented. Discipline should be correctional not punitive Discipline provides the behavioral framework in an organization. Joubert (1998) believes that discipline is vital for trust, risk assurance, good governance, behavioral order, protection of rights, goodwill, integrity, ownership and asset management The safety manager should properly enact the disciplinary role, without discipline everything would fall apart.

7. DIRECTOR ROLE

This is one of the important roles for safety managers. In this case the leader is supposed to be a torchbearer He must provide a vision that others will follow In this case the safety manager envisions the future, and specifically mapping out how to arrive at the future (Farkas et al, 1995). This is a proactive role; this role needs a leader who can see behind the "hills" A number of safety managers are deeply engrossed in accident investigation. To reverse this situation, safety managers should provide a vision Without envisioning safety performance would suffer. Rail safety managers need to envision the safety scenario. This is a major weakness in the railway. Rail safety managers must take heed of Peter Druker's advice: " you cannot build performance on weaknesses" (1999). Safety manager should develop a" mindsight" vision. The safety manager should ensure that his organization does not suffer from paradigm paralysis.

8. MONITOR ROLE

Safety performance should be monitored at all times Quinn et al (1996) argued that monitoring is not tantamount to surveillance They maintain that monitoring is vital for maintaining high performance in both individuals and groups. Monitoring should answer the following questions· what are the core processes that are vital for my work? How effectively are we conducting these activities? Are we getting better at them? Mathebula (1999) maintains that monitoring is like a reverse gear, it enables the organization to revisit its activities A rail safety manager should always enact the monitoring role. Good monitoring is effective information gathering on safety performance. This involves the gathering of statistics on safety performance and addressing deviations.

9. INNOVATOR ROLE

We live in an ever-changing environment. The safety manager should also be a change agent Managers are responsible, as Kouzes and Postner(1995) state, for challenging the process "search out new opportunities to change, grow, innovate, and improve" A safety manager should understand the impact that change has on individuals and how he can help individuals to cope with change. There is a human cost of ignoring emotions on the job. For example, in a gas plant division in Canada accidents were a commonplace because safety managers didn't understand the impact of change on individuals (Goleman, 1998) The safety manager should initiate and implement change. The safety manager should also be in a position to delegate According Covey (1989), they're two kinds of delegation Gofer delegation, is where you tell a person what to do and how to do it. On the other side, stewardship delegation, where you tell a person what to do, but you do not tell him how to do it.

10. FACILITATOR ROLE

This role compels managers to work with a group of people This calls for a leader to manage interpersonal conflict. Today's organizations are project driven, the leader should be in a position to build a team, which will accomplish results There are different types of teams, for example, cross-functional teams, corrective teams, self-directed teams and continuous improvement teams It should be understood that it is difficult to build relationships because we tend to function more easily as individuals. The safety manager should also understand a team life cycle For example, **infant stage, adolescent stage, young adult stage, established performer stage and disbandment stage** (Capezio, 1998). A number of rail safety managers are failing when it comes to the facilitator role, in their view they think that this role should be played by the human resources department. It is high time for African safety managers to move from teams to tribes In a tribe, you have the folklore, tribe loyalty and tribe accountability, these elements are difficult to find in a team. A safety manager should also know the difference between a team and a group Interviewees in the ***Harnessing the potential of Group*** survey established the difference between a group and a team. "The word group tended to be associated with collections or sets of people with certain common characteristics, while the term team tended to be attached to those groups that are cooperating together for some shared purpose"(Thomas, 1997). The safety manager should know how to work with a group or a team. This role needs a manager who exercises Emotional Intelligence

COMPETENCIES

These roles should be matched with a number of competencies It is very difficult to enact a role if you do not have the necessary competencies These competencies must eventually lead an organization to a competitive advantage.

Table 2 provides a matrix, which matches the competencies with each of the 10 roles

Collaboration: Ability to help others find consensus on issues or disagreements.
Diagnosis: Ability to research, reveal, and understand the root causes of organization, process, or team problems.
Feedback. Communicating and insuring authentic two-way communication.
Self–Awareness: knowing one's internal states, preferences, resources, and intuitions
Self-Regulation Managing one's internal states, impulses, and resources.
Motivation: Emotional tendencies that guide or facilitate reaching goals.
Empathy: Awareness of others' feelings, needs, and concerns
Social Skills: Adeptness at inducing desirable responses in others
Questioning or cross examination skills: Objectively gathering information by various questioning methods to stimulate creativity and learning.
Relationship Skills: Successful application of verbal and nonverbal communication skills.
Intervention. Ability to objectively diagnose a situation and know what action is appropriate to take.
Group process: Understanding of group development processes.

TABLE 2
THE RELATIONSHIP BETWEEN ROLES AND COMPETENCIES

TABLE 2(A)

COMPETENCIES

ROLES	Collaboration	Diagnosis	Feedback	Self-Awareness	Self-Regulation	Motivation
Communicator	X		X			
Energizer		X		X	X	X
Preventive	X	X				X
Counselor	X		X			X
Coach	X		X			X
Disciplinary				X	X	
Director	X	X				
Monitor	X	X	X			
Innovator	X	X		X	X	X
Facilitator	X					X

TABLE 2(B)

COMPETENCIES

ROLES	Empathy	Social Skills	Ques-tioning	Relation-ship Skills	Inter-vention	Group Process
Communicator			X	X		X
Energizer	X	X		X	X	
Preventive				X	X	
Counselor	X	X		X	X	
Coach	X	X		X	X	
Disciplinary			X	X		
Director		X		X	X	
Monitor			X	X		X
Innovator	X	X		X		
Facilitator	X	X		X	X	X

CONCLUSION

Safety management needs thinkers of great thoughts and doers of great deeds. This would call for considerable dexterity on the part of safety managers It is not enough to enact a role without mastering competencies associated with that specific role The heroes of the future would be those safety managers who would move out of the stifling fog of old paradigms into the new paradigms. At Spoornet we believe that education is vital for safety performance. Our managers are currently being trained to master different roles and competencies We firmly believe that with excellently equipped managers all injuries can be prevented and all exposures can be safeguarded. The major challenge of this century is to move from a blame culture to energizing employees Employees must be recognized emotionally and intellectually As management we must acknowledge that employees are both appreciating assets to be developed and depreciating cost to be managed We should continually search for ways to engage our employees for the common good of safety performance. In the words of the great poet T.S Eliot.

We shall not cease from exploring
And the end of our exploring
Will be to arrive where we started
And know the place for the first time

ANNEXTURE A

DEFINITION OF CONCEPTS:

a) SAFETY
According to Bird (1996) safety is defined as control of accidental loss

b) COMPETENCE
By competence, we mean not only all forms of available assets, capabilities and knowledge, know-how and skills, technologies and equipment in the organization, but also the coordinated deployment of the above assets and capabilities

c) PARADIGM SHIFT
Change in approach or philosophy.

d) PARADIGM PARALYSIS
When people cling to failed paradigms precisely because it was yesterday's successful innovation. Whatever the cause, the result is paradigm paralysis (Sheehy et at, 1996).

e) EMOTIONAL INTELLIGENCE
Emotional Intelligence refers to the capacity of recognizing our feelings and those of others, to motivate ourselves, and to manage emotions well in our relationships (Goleman, 1998).

f) ENTROPY
Entropy means chaos, the tendency for things to deteriorate (Dennis, 1997)

BIBLIOGRAPHY

1. Bird, F.E 1996 *Loss Control Management: Practice Loss Control Leadership.* Det Norske Veritas, USA
2. Capezio P 1998. *Winning Teams: Making your team productive and successful.* National Press Publishers
3. Chiat, W. 1998 *"New Roles for Public Agency Managers."* American Society for Quality. 53 Quality Conference
4 Covey, R S 1989 *The Seven Habits of Highly Effective People.* Simon and Schuster Ltd
5. Dennis. P 1997. *Quality, Safety and Environment:* Synergy in the 21st Century: ASQC Quality Press
6. Dickens, F and Dickens, J.B. 1991 *The Black Manager: Making it in the Corporate World.* AMACON, New York, USA.
7. Drucker, P. F 1999 *"Managing Oneself."* Harvard Business Review.
8. Drucker, P.F. 1996. *"Toward the New Organisation."* Jossey – Brass Inc.
9. Downer, L and Mui, C 1998 *"Unleashing The Killer Application."* Boston MA: Harvard Business Review.

10. Farkas, C , De Backer, P , Sheppard, A. 1995 *Maximum Leadership: The World Top Business leaders discuss how they add value to their companies."* Great Britain
11. Goleman, D 1998 *Working with Emotional Intelligence.* Bloombery Publishing. Great Britain
12 Joubert, D 1998 *Competitive firms thrive on instinct: Best Practice To Unleash Global Competitiveness.* Queillence Publishers Cape Town.
13 Korten, D.C. 1999 *The Post Corporate World.* Kumarian Poress Inc. and Berrett – Koehler Publishing Inc.
14. Kouzes, J.M. and Postner, B.Z. 1995. *The Leadership Challenge: How To Keep Getting Extraordinary Things Done in Organisations.* Jossey- Brass. San Francisco.
15 Mathebula, M. 1999 *"Linking Employee Engagement to Safety Performance: A Human Assets Approach.* Railway Safety Conference. Canada.
16. Mintzberg, H. 1998. *The manager's Job: Folklore and Fact.* Harvard Business Review on Leadership, USA
17. Nelson, B 1997. *1001 Ways to Energise Employees.* Workman Publishing. New York.
18. Quinn, R E and Faermen, S.R., Thomas, M.P , and McGrath, M.R. 1996. *Becoming a Master Manager: A Competency Framework.* John Willey & Sons Inc.
19. Rubinstein, M & Firsteinberg, I.R. 999 *The Minding Organisation: Bringing the furture to the present and turn creative ideas into Business Solutions.* John Willey & Sons Inc.
20. Shaw, R.B 1978. *A History of Railroads Accidents: Safety precautions and Operating Practices.* Vaal & Ballon Press Inc. USA.
21 Sheehy, B., Bracey, H. & Fraxier, R. 1998. *Strategies to create competitive advantage in the emerging "Age of Abundance."* AMACON.
22. Smith, F. and Kelly, T 1997 *" Human Capital In the Digital Economy". Jossey-Brass Inc.*
23. Spoornet Industry Programme Spoornet's Business Challenge -1996 Mercer Management Consulting
24. Thomas, C C. 1997 *The Future of the Organisation: Achieving Excellence through Business Transformation.* Kogan Page Limited Great Britain.

2000 LONDON

8 November - 10 November 2000
Forum Hotel, London, United Kingdom

Paper 0036

Terry Burtch

Improving Safety is NO Accident

Publisher
2000 International Rail Safety Conference

International Rail Safety Conference

(

Terry Burtch

Director General, Rail Safety

Transport Canada

(

<u>Improving Safety is No Accident</u>

IMPROVING SAFETY IS NO ACCIDENT

Introduction

Canada, as with many other countries, has experienced significant changes in the evolution of its railway system, overall safety performance, and regulatory activities. At the beginning of the last century, railways were predominant movers of both people and goods as Canada grew and expanded westward. A century later, trucking has displaced much of the freight traffic, automobiles and aircraft have become the major movers of people, and much of our movement is north-south.

However, the railway system in Canada is still a major contributor to the national economy, moving millions of tonnes of freight nationally and internationally, and transporting millions of Canadians on commuter and inter-city voyages. The industry is continuing to change rapidly, with new railway companies taking over older lines, new technologies, a rapidly changing and increasingly better educated workforce, and more interfaces with communities and the public.

These trends were confirmed in a recent scan of rail safety stakeholders (Reference 1), as follows:

> "The over-arching message, however, was change --- change at a rate that appears to be increasing, rather than slowing and appears to pervade the entire rail sector. Large railway companies continue to restructure. Smaller railway companies are beginning to re-align and re-consolidate themselves. Labour groups are involved in re-alignment initiatives. The Rail Safety Program, itself is undergoing redesign.
>
> The challenge for all stakeholders in railway safety, therefore, is to manage the change, while remaining focused on safety."

The purpose of this paper is to illustrate, through some examples, how our legislative, regulatory and operational activities have evolved in the last five years – and how we anticipate they will need to change in the next five years.

Safety Management Lessons Learned – Case 1

This first case relates to designing safety in at the outset, and to some degree, the regulator's role in initial integrity.

In 1995, a regional railway approached the Department indicating its intention to operate certain dedicated freight trains with a single operator. At the time, these trains were operated with a two or three person crew. In preliminary discussions with the company, the Department noted that they did not require our approval, as long as they respected

existing regulations and rules under the *Railway Safety Act*. However, certain concerns were raised informally, such as management of fatigue, emergency response in case of injury, qualifications and some others It was also suggested that the company examine other such operations (primarily in other countries) for safety lessons learned.
By early 1996, the company was increasingly committed to this approach and was in negotiations with its employees. I should note at this time that this is a remote operation on wholly owned, signalized trackage, with five public crossings, sparsely populated areas, and maximum train speeds of less than 40 miles per hour. Again on an informal basis, it was subsequently suggested to the company that there may be certain regulatory restrictions, and that they should examine the proposed operation to determine if formal exemptions were needed.

In July 1996, the company commenced this one-person operation very shortly after reaching a negotiated settlement with their employees. The next day, there was a major accident – fortunately, with no serious injury. Almost immediately thereafter, based on our investigation and information forthcoming from the Transportation Safety Board, Transport Canada took regulatory action to require reinstatement of two-person crews pending certain actions, including formal submission of an exemption from certain operating rules.

During the next two months, after a variety of discussions, the Department formally advised the company that their proposed exemptions could not be approved until a number of specific areas were addressed. As a fundamental principle, the company was advised that they needed to be able to demonstrate that the level of safety would be equivalent, if not improved. Over the next few months, based on this direction, the company worked with employee representatives and Transport Canada to develop a structured operational plan for one-person operations. Transport Canada ultimately approved the plan -which included sixty-nine components - and provided an exemption. In July 1997, the company began its one-person operation. The operation continues to this day, and based on safety performance and technological change, has evolved even further.

So, what lessons were learned from this experience? The first was that any such proposed changes must be discussed in a formalized manner. The informal nature of the initial discussions meant that there was no record of issues raised, and no means of assessing the proposal. The second lesson was that the proponent of changes, typically the industry, must be able to demonstrate that they have examined the associated risks and established suitable means to eliminate or mitigate them. The third lesson was that the regulator must be able to establish measures to determine acceptability of proposed actions. Finally, and certainly not least, there must be some means for employees to be aware of such changes, and contribute to safety solutions.

Safety Management Lessons Learned – Case 2

The second case I will discuss was developing in the period of 1997 and 1998, and again relates to designing safety in before changes occur. The railway company is an inter city passenger railway company, operating over thousands of miles of track owned by different railway companies. At the time, the train crews included two qualified locomotive engineers in the head-end, and a qualified conductor in the body of the train. The company had decided that they wished to eliminate the position of conductor. In this case, there was no need to seek any regulatory exemption from Transport Canada.

When the company approached Transport Canada, the Department advised them that it was their responsibility to undertake a thorough examination of the proposed change, identify potential risk areas, and demonstrate that they had effectively mitigated such risks. The Department also provided the company with a written confirmation of this approach, as well as a preliminary listing of potential areas of concern.

To make things more interesting, in September 1997, an inter city passenger train operated by this company derailed, resulting in numerous serious injuries and one passenger fatality. The cause was determined to be a failed axle on one of the locomotives, which raised a number of significant safety concerns. In addition, it was evident that a number of passenger safety features – identified in earlier accidents – had still not been entirely rectified. Partially in response to this accident, the Minister of Transport requested a review of the *Railway Safety Act* and its administration. This review, amongst numerous other recommendations, included a regulatory authority for requiring formalized safety management systems (Reference 2). This requirement reflected many of the same lessons mentioned earlier.

Over the next year, the company developed a formal plan for this proposed operation. The plan included specific concerns, plans, targets and evaluation of activities. In July 1998, the company introduced the change, with no adverse effects. While there are continuing internal operational improvements, there have not been any safety issues associated with this change. In addition, the company ensured that all of the passenger safety issues identified in earlier accidents were rectified prior to beginning this new operation.

What *new* lessons were learned from this case? The first is that the lessons learned from the first case, when applied diligently, are critical to safe introduction of operational changes. The second was that the framework used in these two significantly different cases was entirely consistent with the recommendations of the Minister of Transport's review committee. The third, and perhaps most important, was that safety management systems could be different for different operations. In other words, it would be essential to ensure that regulatory requirements for Safety Management Systems were stringent, yet adaptable to the needs of the railway company and its employees.

Safety Management as a Regulatory Matter

Professor Malcolm Sparrow of Harvard University has written a recent book "The Regulatory Craft" (Reference 3). In this text, he suggests that the "craft" or "practice" be about controlling risks, solving problems and managing compliance. He also examines numerous examples of regulatory programs, the tension between the "enforcement" strategy and the "preventive" strategy, and the notions of risk management. In the end, he suggests that the "new regulatory craftsmanship" is "...to *pick important problems and fix them.*"

This notion is exactly what our legislation is attempting to achieve in future, and is consistent with the objectives contained in the *Railway Safety Act*:

> " (a) promote and provide for the safety of the public and personnel, and the protection of property and the environment, in the operation of railways;
>
> (b) encourage the collaboration and participation of interested parties in improving railway safety;
>
> (c) recognize the responsibility of railway companies in ensuring the safety of their operations; and
>
> (d) facilitate a modern, flexible and efficient regulatory scheme that will ensure the continuing enhancement of railway safety." (Reference 4)

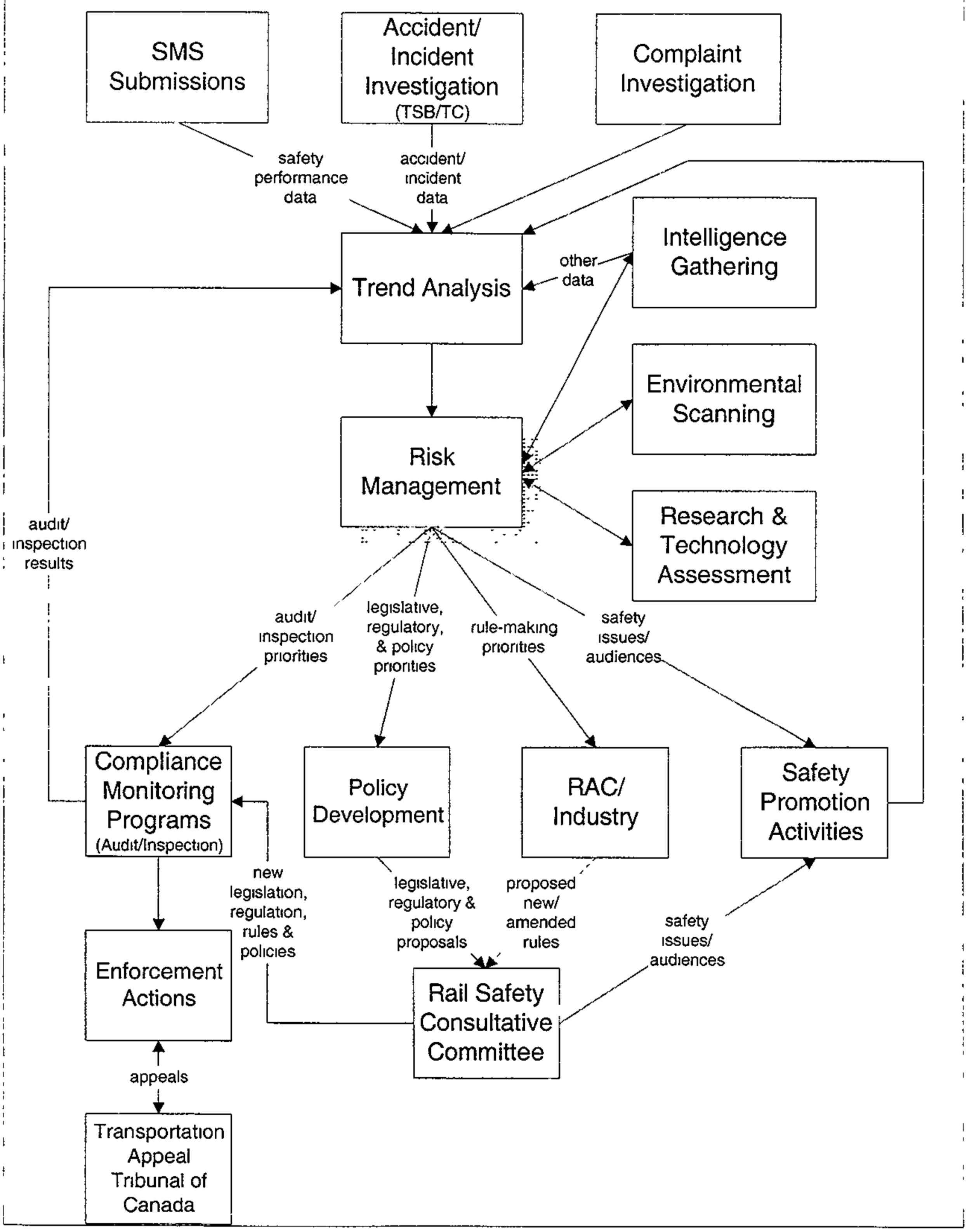
In addition, we are attempting to provide more structure to this framework through a new regulation governing Safety Management Systems for railway companies. Again, we can see from the definition of such a System (Reference 4) that it requires a systematic approach to identifying risks and dealing with them:

> "...a formal framework for integrating safety into day-to-day railway operations and includes safety goals and performance targets, risk assessments, responsibilities and authorities, rules and procedures, and monitoring and evaluation processes"

The detailed regulation has been drafted, and will shortly become law. It contains 12 specific elements to be in place, including safety policies, accountabilities, employee involvement, issues identification, risk control strategies, accident reporting, control of third parties, and internal audits. In addition, there are formal annual filing requirements. (Reference 5)

The final element of our approach is how we, as regulators, intend to act. This question was at the heart of our recent organizational design strategy (Reference 6). In the end, as Figure 1 demonstrates, we recognize that we have to be able to use a far more integrated

Figure 1
SAFETY OVERSIGHT FRAMEWORK



approach to *why* we are doing our activities. Or, to repeat Professor Sparrow's words, to "*...pick important problems and fix them*".

This is a shift from our normal past practice, although we have on occasion clearly used this model. What it means for us is quite simple. We need to ensure our staff is trained in the intent of this new regulation, that they have the tools (training, data systems, technology) to assess compliance, and that we take action when needed to address concerns.

Safety Management Today – Case 3

The final case I would like to use is a current one that has not reached its conclusion. Two years ago, at the International Rail Safety Conference in Sydney, Australia, I described the need for more modern safety frameworks, citing as one example, passenger equipment that is designed to differing regulatory requirements. At present, in Canada, an inter-city rail passenger company wishes to purchase equipment designed and built to European requirements. These requirements are not the same as existing Canadian standards.

Fortunately for all concerned, our existing regulatory framework and the lessons learned in safety management of change provide guidance on dealing with this concern. At the end of the day, the company recognizes that they must be able to satisfy both themselves and the regulator that safety will not be compromised if this equipment is used on the Canadian network.

At the time of this paper, the new regulation on Safety Management Systems is not yet in force. However, many of the basic elements are either in place already or being introduced. As we have tried to illustrate in our earlier examples, these approaches were necessary in the final analysis to ensure change was managed safely.

In order to do this, they are expected to use the Safety Management System principles mentioned above. This involves assessments of the safety performance of this equipment, identification of regulatory differences and how associated risks can be eliminated or mitigated, and assurance that all affected parties have been consulted. This is particularly critical in our framework, because we do not have any authority for licensing of equipment, staff or infrastructure, and pre-approval is generally only required where there is a departure from existing regulations, rules or orders.

To date, in order to address the issues, the company has had to develop a structured approach. This has included analysis of requirements, computer modeling, assessments of alternative standards, identification of modifications, consultations with employees and host railways, and on-going communication with the regulator. They are also well advanced in developing their company's formal safety management system (in line with proposed regulatory requirements). As a regulator, it is our expectation that they will have used this system to examine all aspects of introducing this new equipment and developed appropriate risk mitigation measures.

Conclusions

The purpose of this paper was to demonstrate that regulation of safety must evolve much as industry needs to evolve. The examples cited show that there are certain essential ingredients to managing safety when things are changing – and it is clear that having these ingrained will go far to ensure that important risk areas are identified and addressed

In Canada, we have opted for a safety regulatory framework that is not prescriptive, yet has measurable safety objectives. The industry has a significant freedom in determining how they will operate – yet, there are boundaries in terms of adequate consultation with affected parties, certain core technical requirements, and, in the very near future, formalized management of safety.

As a regulator, we also have significant freedom in terms of our activities and actions. We have the usual range of compliance and enforcement tools at our disposal – yet we intend to use more formalized strategies and tools to guide our actions.

In summary, the government has established, through legislation and regulation, *what* is expected of safety management in industry and *who* is involved. The industry, in turn, is responsible for *how* they will meet this obligation, and have scope to tailor these systems to their specific operations and risks. This will be even more important in future as industry continues to change in structure, technology and people. It will be equally critical for us, as regulators, to ensure we keep pace.

REFERENCES

1. Consulting and Audit Canada, "Environmental Scan", Ottawa, Canada. 1999.

2. Transport Canada, "Review of the Railway Safety Act Amendments and Safety Oversight and Regulatory Compliance Mechanisms" (TP13151E), Ottawa, Canada. January 1998

3. Sparrow, Malcolm K., "The Regulatory Craft", Brookings Institution Press, Washington, DC, USA. 2000.

5. Government of Canada, "Railway Safety Act, 1999, An Overview"(TP10199), Ottawa, Canada. December 1999.

6. Transport Canada, "A Guide on the Development and Implementation of Railway Safety Management Systems" (TP13548), Ottawa, Canada. February 2000.

7. Consulting and Audit Canada, "Rail Safety Program Strategic Overview", Ottawa, Canada. November 1999.

International Rail Safety Conference

2000 LONDON

8 November - 10 November 2000
Forum Hotel, London, United Kingdom

Paper 0037

Yoshihira Fukushima
Hiroyuki Suenaga

Information offering to a train crew
- with consideration of human factors -

Publisher
2000 International Rail Safety Conference

International Rail Safety Conference

Yoshihira Fukushima

Deputy Director &

Hiroyuki Suenaga

Assistant Manager

East Japan Railway Company

Information Offering to Training Crew

Information offering to a train crew

- with consideration of human factors -

8-10 November 2000

YOSHIHIRA FUKUSHIMA
HIROYUKI SUENAGA
Safety Research Laboratory
East Japan Railway Company

1. INTRODUCTION

JR East has been established for 14 years.
Although the total traveling kilometers of trains and the traffic volume (passenger x kilometer) have increased by 10% or more and 20% or more, respectively, since its establishment, the number of railway accidents has decreased to 40% or less of that at the time of establishment. We believe that this has been achieved by individual employee's sincere efforts and measures taken for ensuring safety train service and the mechanization and systematization promoted through the introduction of new technologies into various fields, including a safety system.

However, we must admit that the driving of a train still depends greatly on driver's memory and concentration. The information offering to a train crew is one of the typical examples. Risk of serious accidents has become extremely low thanks to the equipment of various devices, such as ATC and ATS, to prevent accidents caused by the misconception of signals. However, the position and classification of these signals still depend on the memory of the driver. Changes of a train service plan are conveyed by means of a piece of paper, called "Train announcing Notice Ticket" which is given by a station staff, who is appointed by a train controller, to every train and every crew or directly by a train controller via train radio. Consequently, when a driving root or a schedule changes due to traffic suspension, the current procedures to offer information to the train crew may obstruct the smooth and prompt restoration of transportation services. As we are keenly demanded to ensure a high quality of transportation service, the improvement of safety and reliability of the railway as a whole is a very important task for all railway companies. And the improvement of information offering to a train crew is one of the important challenge.

This report discusses our efforts to improve the information offering system from the following 3 viewpoints together with the past progress.

(1) Control of a train
(2) Conveying traffic controllers' information
(3) Information service to train passengers in case of traffic suspension
[Figure 1]

2. The present status of information offering to a train crew and a direction of improvement

2-1 Control of a train

2-1-1 [Present status]

Information which a driver should have when operating a train in a wayside signal system includes rules of driving and an operation manual, locations of signals, points of speed limit and stopping singes. Many of the information are only in driver's memory.
The shapes of signals and singes are standardized. However, as the method of installation differs depending on the linear shape of the line and do not necessarily comply with rules, it may be difficult for the driver to remember them accurately.

Drivers must memorize information necessary for controlling a train. First they collect information from a "rail map" which depicts linear shapes of line and driving facilities, and a "yard map" which describes linear shapes of train depots and driving facilities. Then, they confirm the wayside facilities by looking from a driving seat of a train, and memorize them. They accumulate these memories by repeated driving of a train. They should be given an appropriate support when going to a line and yard for the first time after a long interval.

2-1-2 [Direction of improvement]

Controlling of a train still depends on driver's memory of the information on relevant facilities. This should be replaced by the information on signals and routes to be given to the drivers on a train by using an advanced information technology.

We have developed a system to offer information to a train crew for the following purposes:

① To help drivers find information about signals and signs etc.

② To simplify the collation of the information received from the way side and the information available on a train.

③ This development has been achieved by the use of general technology rather than the technology which has been used exclusively for railway, and by taking account easy maintenance of information by drivers.

As drivers with different experience require different supporting information, this system allow the driver to select items of information as required. The most important feature of this information offering system is that the visual information on the display can be easily collated with what the driver sees with his eyes. Shunting signals on the wayside are numbered for helping clearer identification of the signals in shunting driving, We apply mainly still photographs as visual information to support driving, and a voice alarm as audio information to warn drivers. As a driver should operate by collating signals or signs on the wayside and information shown on the cab display under this system, We have to consider about the Man Machine Interface for the system. Research and development is now underway by taking drivers opinions into account. [Figure 2]

2-2. Conveying traffic controllers' information

2-2-1 [Present status]

When a trouble occurs, a traffic controller needs to change a traffic schedule and informs station staffs, managers of transportation depots and train crews details of the change. Even now, we have two procedures to convey information to a train crew. One is through the station staff, another is using a train radio. With the former method, the station staff writes a direction in a peace of paper and delivers it to the train crew.
This ticket is called "Train Announcing Ticket".

This method requires time and efforts, and contains the possibility of involving a human error. The train crew should wait some time until they receive information even if a new schedule has been determined early, because the number of stations that can issue "Train Announcing Tickets" is limited. In addition, station staffs sometimes have to write and deliver the "Train Announcing Tickets" when they are extremely busy in providing passengers services. With the latter method, the train crew gets the information directly from the traffic controller through the train radio, writes it on the "Train Announcing Ticket" by himself and repeats it to the traffic controller. One of the problems associated with this method is that there is only one channel for one line in the train radio, and it takes long time to complete three steps in the procedure. As mentioned above, weakness of the present procedures may disturb the restoration of the train schedule or cause further delay of the schedule. When traffic suspension is caused in the Tokyo metropolitan, information for passengers is broadcast in all trains through the train radio, and then the conductors catch and note the information and announce it for passengers. However, they sometime fail to catch the information, and cannot give adequate information to the passengers. Moreover, the quality of announcement depends on a conductor's skill.

2-2-2 [Direction of improvement]

We developed a new procedure for the traffic controller to convey information directly to the train crews via E-mail on a general-purpose information network. We laid an exclusive line between the traffic control center and a network company, and use a packet radio communication network between the base antenna and the train. Security of this system is ensured by the exclusive line and a unique ID of the on-board packet radio terminal.

The workflow of this system is outlined as follows.

①The traffic controller input information on the changes of the schedule into the "controller's terminal".

②This information is displayed on the "on-board terminal" of the concerned train.

③The train crew checks the information and responds by inputting "confirming the information" into the "on-board terminal".

④The traffic controller then knows that the train crew has confirmed the information.
[Figure 3]

We have developed the "Man-Machine-Interface" of the traffic controller and the train crew. The traffic controller has to input a lot of data in a short period of time, and the train crew has to understand the information immediately. In this system, the traffic controller can convey the information without taking notice of the train position. The system is equipped with a function to prevent human-errors, so that the traffic controller can convey the information to the train crew without fail. A data input form of this system is defined by type of "Train Announcing". The "Traffic Controller Terminal" identifies the lack or logical-error of input data and send an alarm. The "Traffic Controller Server" seeks the train position and checks whether the train is in the positions where the information on the changed schedule can be received. "On-board terminal" alarms that the train crew should reconfirm the information before the train arrives at the station on which the schedule changes. We are now developing a subsystem that automatically translates the data of train control system into "Train Announcing".
The Shinkansen train of JR East is scheduled to employ the system in which "Train Announcing" is shown on the display in the cab along with the digitalization of the train radio in 2002.

2-3. Information service to train passengers in case of traffic suspension

2-3-1 [Present status]

JR East operates more than 12,000 trains per day. Average delay per train is less than 1.0 minute. Accordingly, passengers expect that these trains should be always punctual. Nevertheless, traffic suspensions are caused sometimes by natural hazards, breakdowns of railway facilities or trains themselves, etc. In the Tokyo metropolitan area, commuter trains carrying about 3,000 passengers run every 2 or 3 minutes during rush hours. In view of the fact that once a trouble occurs in the area, thousands of people have to stay in a station, an adequate information service is very important. It is needless to say that the prevention of traffic suspension is most important. Once such trouble occurs, however, conductors and station staffs should provide information (expected resuming time, present situation of restoration on the site, alternative route, etc.), so that passengers can decide promptly what they can and should do next.

The information regarding the troubled site is collected and pooled in the traffic control center, and is conveyed to conductors and station staffs through the train radio or telephone. It is then conveyed by the conductors and station staff to the passengers through announcements and notices. The "scrolling announcement boards " which can display information from the traffic control center on the LED screen are going to be installed in stations with the introduction of a new train control system (ATOS). When the train operation is suspended, the information as to when the service will be resumed is most important for the passengers. However, it may be difficult to estimate the resuming time quickly in accidents of certain types and levels. Keeping the importance of this information in mind, we make utmost efforts, including finding an appropriate way to give the information to the passengers.

2-3-2 [Direction of improvement]

In January 2000, a questionnaire survey was conducted on about 500 passengers with a purpose to find their needs of information in case of traffic suspension. Results of the survey revealed that many passengers required the information as to when the train service resumes, and that most of them permitted a slight difference between estimated and actual resuming times. It also revealed that the passengers used alternative transportation means when they knew the suspension would continue over 60 min. This indicates that when the suspension was expected to exceed 60 min and even if the supply of the estimated resuming time is difficult, the information is most useful for the passengers. Contents

Safety Research Laboratory is now considering the contents for offering information to train passengers based on the results of this study.

3. Conclusion

Passengers, who use a cellular phone to access a web site of traffic information, may have more detailed information than the railway staff.

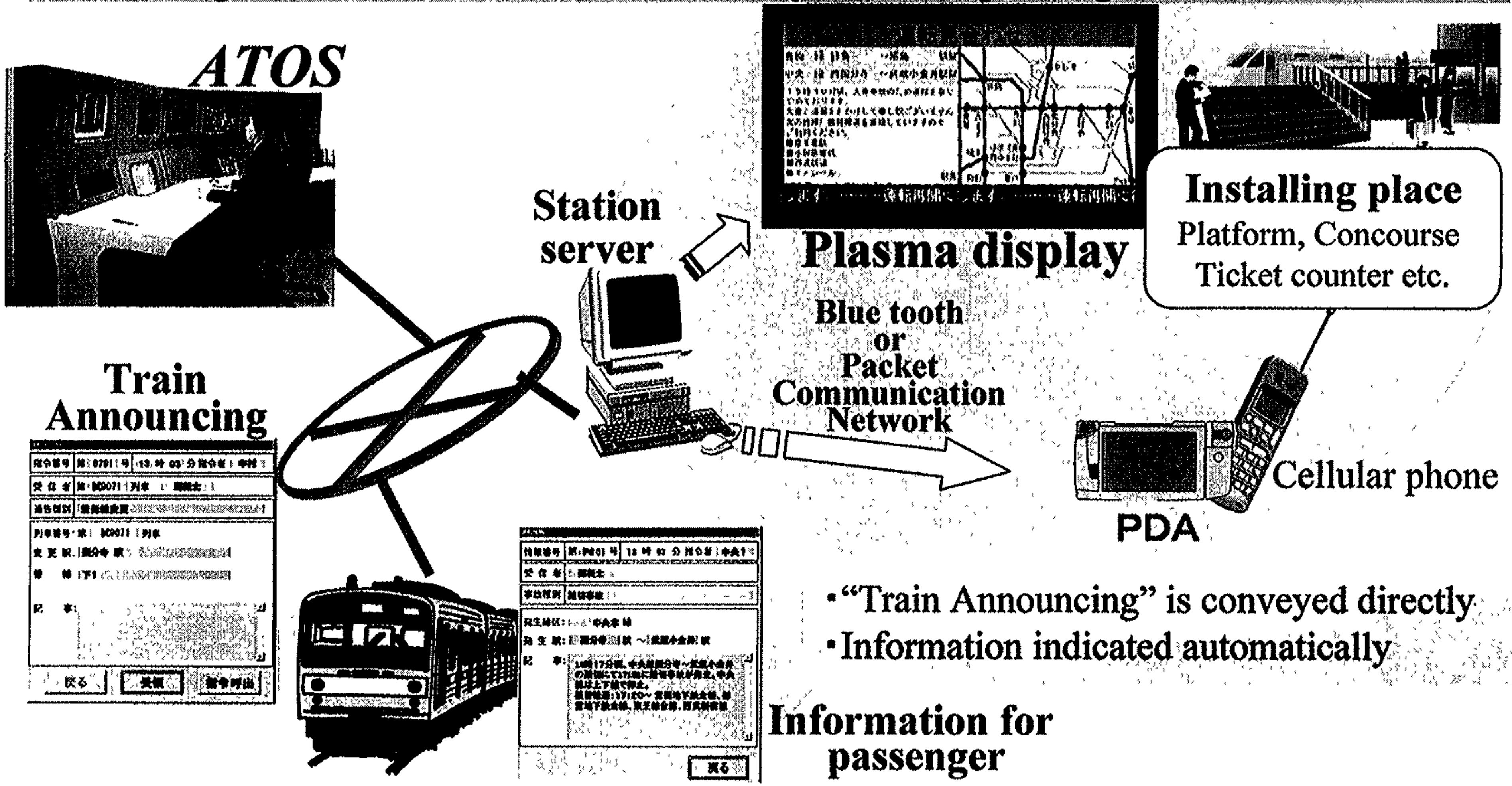
In comparison with this fact, there is still room for improvement in our system to offer information to the railway staff. We should promote our efforts to develop adequate information system using the latest information technology.

Figure 1

Information offering to a train crew

Objective
- Providing passenger services & decreasing employees trouble

Subject
- Offering service information at flexible and realtime by ATOS data
- Providing sufficient information for railway staff and passengers



- "Train Announcing" is conveyed directly
- Information indicated automatically

Figure 2

Structure of The Driving Support System

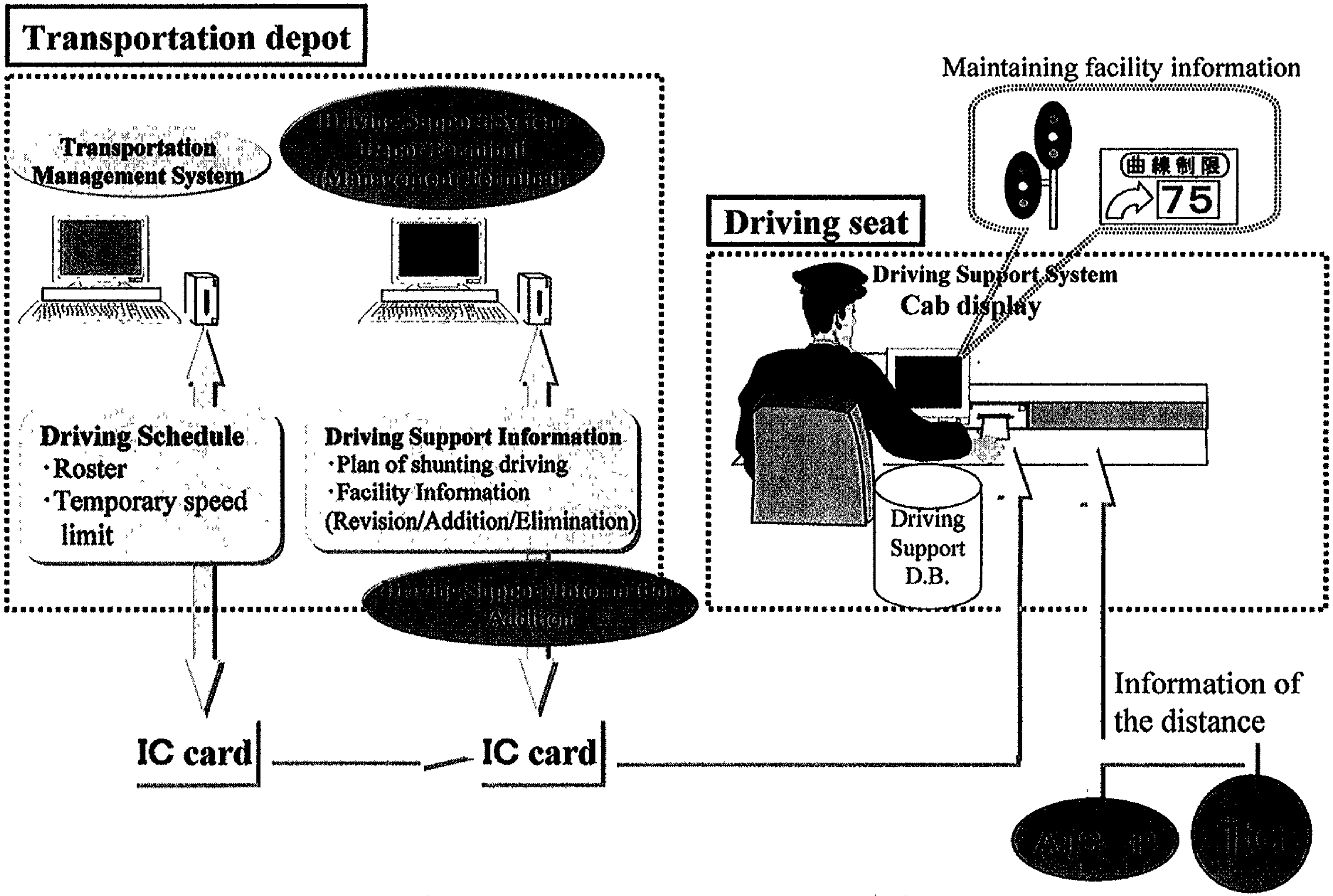
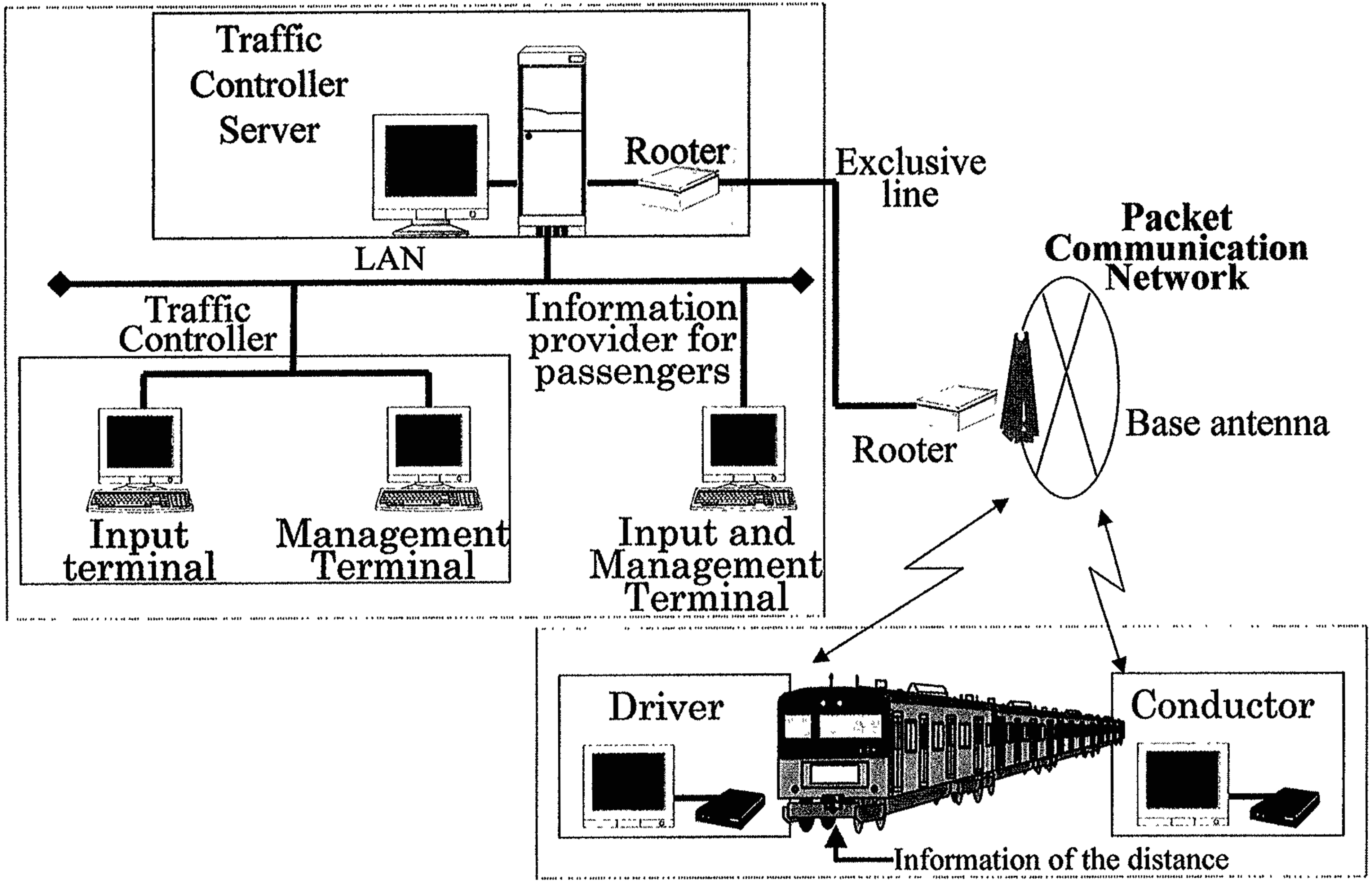


Figure 3

Structure of The Information Offering System



2000 LONDON

8 November - 10 November 2000
Forum Hotel, London, United Kingdom

Paper 0038

Extract from the Public Inquiry report conducted by The commission appointed to examine the facts of the accident which involved two trains colliding head-on on 4 January 2000 at Asta, Norway. 19 persons were killed and 67 injured

Publisher
2000 International Rail Safety Conference

PUBLIC INQUIRY REPORT:
ÅSTA - ACCIDENT 4. JANUARY 2000
(where 19 people lost their lives)

12 Summary

The following is a brief summary of important facts dealt with in the report, the main issues, the views of the commission and its recommendations. We would like to point out that in summarizing the main points in this manner, certain shades of meaning may be lost. As far as the recommendations are concerned, only the individual recommendation itself has been included, without the text explaining its basis. The commission has based its recommendation on the situation as it was on 4 January 2000.

12.1 Appointment of the commission and its work

The day after the accident, 5 January 2000, it was decided to appoint a commission of inquiry that was independent of the Norwegian National Railway Administration and the Norwegian State Railway (NSB BA).

The following were appointed members of the commission:

1. Judge Vibecke Groth, Borgarting Court of Appeals, chair
2. Øystein Skogstad, chartered engineer, SINTEF (Foundation for Scientific and Industrial Research at the Norwegian Institute of Technology)
3. Finn Mørch Andersen, chartered engineer, Directorate for Fire and Explosion Prevention
4. Ingemar Pålsson, chartered engineer, Det norske Veritas, Gothenburg, Sweden
5. Marika Kolbenstvedt, sociologist, Institute of Transport Economics.

The above were appointed by Royal Decree of 7 January 2000. The commission was expanded to include another member, Joakim Böcher, engineer, Det norske Veritas, Denmark, on 26 July 2000. Secretary to the commission was Jacob Ferdinand Bull, associate, of the law firm Arntzen, Underland & Co.

The commission's mandate was to examine the facts of the accident in order to establish its cause and propose action that in the view of the commission should be taken to prevent similar accidents in the future.

A few days after the commission was appointed, it commissioned SINTEF to undertake a technical review of the signalling system to reveal any physical malfunction. This work was assessed by Railcert, The Netherlands.

The commission also requested an expert opinion from the Swedish National Rail Administration on the condition of points no. 2 at Rudstad station on the day of the accident. In addition, the Commission has received and evaluated the following reports from the police, the commission of inquiry appointed by the Norwegian National Railway Administration and the NSB BA commission of inquiry:

- Provisional report from the Norwegian National Railway Administration accident commission.
- Norwegian National Railway Administration accident commission interim reports 1, 2 and 3.
- Draft report from the NSB BA accident commission.
- Report from the police investigation into the cause of the accident.

The commission has interviewed a total of 96 witnesses. All statements made to the police and any documents or other information that might be of interest from the police investigation conducted in parallel with the commission's own investigations have been made available to the commission. In addition, the commission has sought important documentation and other material of importance to its investigations from the National Railway Administration, NSB BA, the Norwegian Railway Inspectorate, the Norwegian Labour Inspection Authority and the Ministry of Transport and Communications.

12.2 The Accident

On the day of the accident, 4 January 2000, the southbound train left Trondheim at 07.45. The train was on schedule and consisted of a diesel-powered locomotive and three carriages. Its destination was Hamar. A new driver boarded the train at Røros and the train was probably 21 minutes late leaving Røros station. By the time the train had arrived at Rena station and departed again, the delay had been reduced to about 7 minutes. There were 75 persons on board, including the driver and conductor, when the train left Rena at 13.07. According to a witness, the line signal at Rena was green and the log taken from the Hamar rail traffic control centre after the accident also indicates that the exit signal was green. A witness working at Rena station saw that the southbound train had received a green exit signal on the local control panel.

The northbound train left Hamar on schedule at 12.30. The train was a BM 92 engine set consisting of an engine and a steering car. The train was scheduled to run to Rena and then back to Hamar. It arrived at Rudstad station on schedule at 13.06, stopped and picked up a passenger. According to the timetable, the train was supposed to wait at Rudstad station from 13.06 until 13.10 for the southbound train to pass. However, the train left Rudstad at 13.07. There were at this point 11 persons on board, including the engine driver and the conductor. The log indicates that the exit signal was not green and that the set of points on the line exiting Rudstad in the direction of Rena had been forced open.

The rail traffic controller responsible for this section of the line was also responsible for the Hamar-Eidsvoll line, where there was heavy traffic. Consequently, for a certain period of time he did not check the screens showing what was happening on the Røros line. An audible alarm to warn of a train on a collision course had not been installed at Hamar rail traffic control centre. Even though a warning displayed in the form of red text 16 millimetres high at the bottom of the screen indicated that points no 2 had been open since 13.08, the rail traffic controller did not realize this until about 13.12.

Neither ATC (Automatic Train Control) nor train radios had been installed on the Røros line. The trains were equipped with mobile telephones. The only way for the rail traffic controller to contact the trains when they are en route between stations was therefore by mobile telephone. Both trains had reported in their phone numbers to the rail traffic controller at Hamar, who went off duty before the accident took place. He had not added these numbers to the list that had been agreed on at the control centre. When the duty rail traffic controller realized that a collision was imminent, he could not find the mobile telephone numbers and could not contact the two trains.

The trains collided at Åsta station between Rudstad and Rena at 13.12.35. The engine car of the northbound train was completely wrecked, while the steering car received minor damage and remained upright on the rails. The locomotive of the southbound train was severely damaged and toppled over onto its side. The front carriage buckled and derailed. The next carriage also derailed, but remained upright. The rear carriage remained on the rails. A major fire broke out immediately in the area around the locomotive and the rest of the engine car, and a few minutes later fire broke out in the front carriage. The fire eventually spread to the remaining two carriages.

19 people were killed in the collision and the subsequent fire. 67 persons survived the accident. None of the survivors was fatally injured.

12.3 Causes of the accident

12.3.1 Possible direct causes

In the view of the commission, the direct cause of the accident must either be a malfunction in the signalling system or human error.

An overall evaluation of the technical documentation indicates that it is unlikely that a technical malfunction could have affected the signalling and safety system functions on the day of the accident. None of the investigations or tests that have been conducted has revealed physical faults in the system that could have had a bearing on the accident. Nor is there any indication of any specific, functional weakness that can with certainty be said to have been the direct cause of the accident. However, because of the design of the safety system, and because of inadequate logging of operational status in the safety system, the commission cannot exclude the possibility of a technical malfunction in connection with the accident. Neither the level of safety nor the quality of the safety system is satisfactory. The possibility of short-term operational malfunctions occurring cannot therefore be excluded.

In the light of the above, the commission cannot state with certainty what signals were showing on the northbound line at Rudstad station on 4 January 2000. From a technical point of view, it would seem highly likely that a red exit signal was showing. At the same time, the design of the safety system makes the potential for error so great that the commission cannot with certainty exclude malfunction situations that may have produced a different signal aspect.

An examination of the "black box" data recorder shows that the driver of the BM 92 engine set drove smoothly and normally from departure at Hamar until the collision occurred. There is no deviation from the normal except for the stop at Rudstad station. The position taken for the stop may indicate that the driver of the locomotive did not expect another train to cross here. A stop in this position would make it impossible for a southbound train to cross over. The short duration of the stop would indicate that the driver of the locomotive believed that the crossing would take place at Rena instead. The train departed from Rudstad three minutes ahead of schedule. This would indicate that the driver was in a hurry to reach Rena so as not to delay the southbound train that would be waiting there. The early departure would also indicate that the conductor may have believed time was short and that he was expecting the crossing to take place at Rena. He was responsible for ensuring that the departure signal was only given at the scheduled time.

In all events, the driver is required to obey the signals. The fact that the driver of the northbound train drove out from Rudstad station is therefore an indication that the exit signal and any advance signal were showing green. Neither the commission nor the police have been able to find any indication that the driver or the conductor received information that moving the crossing to Rena was being considered, or that the southbound train was delayed so that a change in location for the crossing could be expected.

The commission cannot with certainty identify the direct cause of the accident that took place on 4 January. Neither a signal malfunction nor human error can be excluded. The signal that technically speaking is most likely to have been shown, a red exit signal, is the signal that a driver of a locomotive is least likely to have driven through. Similarly, the least likely signal technically speaking is the green exit signal, the all-clear signal for the driver of a locomotive.

However, it has been established that although the trains involved were on a collision course for four and a half minutes, the collision was not prevented. How this could happen is in the view of the commission just as important to establish as the direct cause of the accident.

12.3.2 Indirect causes

We know that technical systems can malfunction. We also know that people make mistakes. Consequently, there must be a safety system to ensure that individual faults do not result in accidents. This has been the guiding principle of safety work for years. Nonetheless, in the Røros incident, a signal failure or a mistaken observation by an engine driver led to a serious accident. ATC had not been installed on the Røros line in spite of the fact that installation had been planned and funding had been allocated. Even though ATC had not been installed, changes in the departure procedure were also introduced on the Røros line. In addition, stations were no longer manned and crossing plans were removed. These changes were made without performing risk analyses for the individual change or for the Røros line. If the Norwegian National Railway Administration had done so, it would and should have been possible to see that an individual fault could lead to an accident.

12.3.2.1 Damage limitation measures

With no barriers to prevent an emergency from arising, there should at least have been measures designed to avert it. The Røros line was not and is not electrified. The trains travelling on the line are therefore diesel-powered. This means that the rail traffic controller does not have the same possibility of stopping the trains as he or she has on an electrified line, where the electricity can be cut in an emergency.

In an emergency, it is at all events vital that the rail traffic controller is aware of the situation. On the Røros line, he would also have to make contact with the trains to stop the situation before the accident happened. At Hamar rail traffic control centre no audible alarm had been installed to warn the rail traffic controller that a dangerous situation had arisen. Nor were there any rules stipulating how often the rail traffic controller should monitor each individual section of the line. Between three and a half to four minutes passed from the time the dangerous situation arose before the rail traffic controller became aware of it.

Train radios allow a rail traffic controller to make contact with the trains when they are travelling between stations. Communication is always possible. However, train radios had not been installed on the Røros line. When the rail traffic controller became aware of the situation, he could not find the correct mobile telephone numbers for the two trains. There were no regulations laid down by a central authority that train personnel should report their mobile telephone numbers to the rail traffic control centre, and there were no regulations for the logging of numbers if they were reported in. At Hamar rail traffic control centre a list was made and it had been agreed that mobile telephone numbers that were reported in would be written down on this list. However, no safety grounds had been given for keeping a list of mobile telephone numbers in spite of the requirement in the regulations of 22 July 1994 that rapid two-way contact between train and control centre should be possible in an emergency. With clear rules and procedures and a focus on the importance of having mobile telephone numbers available in an emergency, it is possible that the rail traffic controller could have made contact with the two trains in time. He would undoubtedly have done so had an audible alarm been installed and he had had a good method of communication with the two trains.

12.3.2.2 Risk and safety management

The Norwegian National Rail Administration should have conducted more risk analyses over the last few years in the light of the changes introduced that affected safety. Furthermore, a risk analysis should have been conducted of the safety level on the individual section of a line, including the Røros line. A risk analysis would have shown that the safety level on the Røros line was far from adequate. Whatever the direct cause of northbound train 2369 incorrectly passing the exit signal at Rudstad station on 4 January 2000, our examination of the reasons why it happened at all, and why the situation was not discovered and stopped at an earlier stage, has revealed a basic lack of a systematic approach to safety issues, particularly within the Norwegian National Rail Administration, whose responsibility it is to ensure that the overall safety of a section of a line is acceptable.

Safety-consciousness and safety management, which in other comparable sectors have been basic principles for many years, have not been implemented in the former NSB and later in the Norwegian National Railway Administration. When the incident-based form of safety management on which safety on the railways has supposedly been based has not been followed either, the result is a system that will only discover that there are basic inadequacies in the safety of a section of line when an accident happens on that particular line. This was allowed to happen on the Røros line on 4 January 2000, but could have been avoided relatively easily if the recommendations that already existed and the plans that had already been made had been implemented.

12.3.3 *Conclusion*

In the view of the commission, the Åsta accident occurred because of basic inadequacies in the Norwegian National Rail Administration with regard to safety consciousness and safety management. This means that the effect that serious and in some cases well-known safety deficiencies on the Røros line had on safety was neither analysed nor followed up. These basic deficiencies in safety management apply to all the aspects of the Norwegian National Rail Administration's activities that the commission has examined and must therefore be regarded as a serious systems failure.

12.4 The rescue operation

Before the Rena fire service arrived at Åsta, passengers who had survived the crash tried to put the fire out using portable fire extinguishers taken from the southbound train. This had little or no effect.

The accident occurred at 13.12.35. The Rena fire service arrived just after half past one. By that time the fire was very severe. Firefighters began by using a high-pressure hose delivering water from the water tank on the fire engine while larger hoses with greater capacity were being laid out. These were also connected to the fire engine water tank. An attempt was made to extinguish the flames using foam, but this had no noticeable effect. There was a brief interruption in the water supply while the hoses were disconnected from the fire engine and reconnected to the water tank truck. This cannot be regarded as having had any significance in the progress of the fire.

All the efforts of the fire service personnel were focused on saving surviving passengers in the front carriage on the southbound train. Several passengers were trapped here. The Elverum fire service arrived at the scene of the accident at 13.47. More water tank trucks were immediately called in and efforts were intensified. However, the firefighters were unable to extinguish the fire or prevent it from continuing to spread in the front carriage during the phase when this was vital to the surviving passengers who were trapped there.

The resources that were applied and the efforts made were sufficient to extinguish a relatively large fire. The reason why it was not possible to extinguish the fire at Åsta in spite of this involved several factors:

- In addition to carriage furnishings, large amounts of diesel were on fire.

- Parts of the site of the fire in the front carriage of the southbound train (carriage no. 3) were inaccessible to the firefighters because of the position of the carriage and the damage it received in the collision.
- The diesel fire outside carriage no. 3 was inaccessible in many places as diesel had collected underneath pieces of wreckage and the carriage. The diesel fire led to extreme temperatures inside the carriage, which in turn reduced the effect of the efforts to put the fire out here.
- After the collision, carriage no. 3 lay at an angle so that once the fire had taken hold in the lowest sections it was very difficult to prevent smoke and heat from spreading to sections higher up.

With the benefit of hindsight, the question might be raised of whether the Elverum fire service should have been dispatched as soon as the emergency services call centre had received the first report of the accident at 13.16. If so, the Elverum fire service would have arrived at Åsta about 10 minutes earlier. Under the current regulations, assistance from the Eleverum fire service would have to be requested as it belongs under another municipality. In the view of the commission, the deputy fire chief in Åmot (for the Rena fire service) did not have sufficient knowledge of the scope of the accident to make such a request any earlier than he did. However, the commission feels it would have been an advantage if assistance from Elverum had arrived sooner.

12.4.1 Priorities set by fire service

It would have been preferable to have a greater supply of water than was actually available since all the water had to be transported to the scene by water tank truck. However, other solutions would have required resources and time that were otherwise spent on efforts focused directly on saving trapped passengers. In the view of the commission, the right choice was made. To establish a water supply from the river Glomma would have taken so long that by the time it had been set up, it would have been too late to save any lives.

The efforts made to free trapped passengers were quickly and professionally carried out. The reason why more passengers could not be saved was primarily the fact that it was not possible to hold the fire back, and consequently there was too little time to complete the complicated and time-consuming work necessary to free people who were trapped between heavy steel structures.

12.5 The commission's recommendations

The commission has the following recommendations:

Main recommendations:

Regarding overall safety management:

The commission recommends that measures should be implemented to ensure that proactive safety management is applied to all railway operations.

Furthermore, the commission recommends that there should be a safety manager for railway operations with a direct line to the top management, whose primary duty is to monitor safety in all parts of the organization and submit proposals for improvements. The following-up and implementation of safety measures must be the responsibility of line management.

The commission recommends that the Norwegian National Railway Administration and NSB BA should intensify their efforts to develop a high quality, efficient internal control systems in all its activities.

In the opinion of the commission, competence requirements and training plans should be drawn up for all staff with responsibility for safety.

The commission recommends the use of risk analyses to assess the risks connected with railway operations, both with regard to overall risk and the consequences of any change that is planned, whether organizational or technical. Every section of line with its infrastructure, rail traffic control centres, rolling stock, procedures and staffing structure should be reviewed in the context of the requirements laid down in current laws and regulations.

In the view of the commission, measures should be implemented to boost staff motivation to report and provide feedback on undesirable incidents in all parts of the organization. A more precise identification of what should be reported and how this should be done should be considered.

The commission recommends that incident reports should be collected and systematized to reveal whether any faults recur and whether they are safety-critical.

The commission holds the opinion that analyses of reported incidents should be made more available in organizations so that connections and other factors that have an impact on safety become more visible.

The commission recommends that the parties involved in railway operations formulate clear rules and procedures for internal accident commissions. Rules and procedures for securing evidence should be given special priority.

In addition, the commission recommends that research should be done into the possibility of equipping all railway lines with reliable logging systems.

Signalling and interlocking system:
The commission holds the opinion that a complete reengineering of interlocking system NSB-87 must be carried out before the system is put back into normal operation and before ATC is installed.

It is also the opinion of the commission that a technical review of interlocking system NSI-63 should be carried out and that this review should be followed up by an external body.

The commission recommends the installation of ATC on the Røros line and on other remote controlled lines where there is at present no ATC. It is recommended that installation should be carried out as soon as possible.

The commission recommends that train radios or other reliable communications equipment is installed on lines that do not at present have this equipment.

The commission believes it is important to introduce procedures and rules for the use of mobile telephones until train radios or other reliable communications equipment has been installed.

The commission recommends that the Norwegian National Railway Administration and NSB BA review the documentation on all technical systems and ensure that it is complete. The documentation should be stored in such a way that the correct documentation is available.

Rail traffic control centres:

The commission recommends that an audible alarm for safety-critical faults should be installed at all rail traffic control centres as soon as possible.

The commission holds the opinion that the Norwegian National Railway Administration should perform a review and assessment of the organization and the general situation at all rail traffic control centres at both the overall and the local level.

Upgrading of old rolling stock:

The commission holds the opinion that old rolling stock should be reviewed and assessed upgraded so that it meets current requirements. In addition the commission recommends that internal rules for maintenance and upgrading should be changed so that they are in accordance with a correct interpretation of Article 97 of the Norwegian constitution.

Other recommendations:

Regulations for railway operations:

It is the view of the commission that existing regulations should be subject to a thorough review with a view to streamlining and simplifying them. Including parts of the internal traffic safety provisions in regulations should be considered.

Norwegian Railway Inspectorate:

The commission recommends that the Norwegian Railway Inspectorate is strengthened by increasing staffing levels. The commission also recommends that more personnel with a background in railway operations should be employed to strengthen communication with and an understanding of the operations that are subject to supervision by the Norwegian Railway Inspectorate.

The commission recommends that the position of the Norwegian Railway Inspectorate as an agency responsible to the Ministry of Transport and Communications should be reconsidered with a view to establishing a more appropriate solution.

Train operation:

In the opinion of the commission, a risk analysis of the new departure procedure should be carried out for the relevant modes of operation.

The commission recommends that information about the normal location for a crossing should again be included in the engine driver's schedule on lines with little traffic.

The commission also recommends that drivers should be given training in the functions and behaviour of the signalling system.

The commission proposes that prohibiting persons other than the engine driver from travelling in the driver's cabin while the train is in operation should be considered.

The commission recommends that clear rules and procedures should be drawn up for cooperation and two-way communication between different rail traffic control centres covering a section of line and between the rail traffic control centres and DROPS.(NSB train operation centres)

Securing technical installations:
The commission holds the opinion that a more modern locking system or other method of securing relay station houses and other locations where technically sensitive equipment is located should be introduced so that only authorized persons have entry.

Diesel tanks:
The commission recommends that measures are researched and implemented to prevent large amounts of diesel fuel from being released in a collision or derailment involving a diesel engine.

Storage of luggage on trains:
The commission recommends that solutions be found for the storage of luggage to prevent passengers from being injured and luggage from being thrown around in accidents, hampering evacuation and the efforts of rescue personnel.

Fire services and emergency call centres:
The commission holds the opinion that municipal fire services should be coordinated in an intermunicipal fire service to a greater degree than at present.

The commission also holds the opinion that the emergency call centres should be equipped to record all calls to the emergency numbers 110, 112 and 113, and all radio communication to and from the centres.

Permanent accident commission, etc:
The commission recommends that the establishment of a permanent commission of inquiry for serious train accidents should be considered. The commission could also be authorized to investigate serious accidents in all the transport sectors. The commission also recommends that a permanent commission be an independent expert body with administrative links to a ministry. Its relationship to the police authority investigating the accident should be clearly established.