International Rail Safety Conference

1999 BANFF

19 October - 22 October 1999
Banff Springs Hotel, Banff National Park, Alberta, Canada

Paper 9900

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R. H. Ballantye

Welcoming Address

Publisher
2000 International Rail Safety Conference

The Railway Association of Canada

WELCOME DELEGATES AND COMPANIONS TO THE TENTH INTERNATIONAL RAIL SAFETY CONFERENCE

The world's first steam-powered commercial railway, the Stockton & Darlington, started operations in the United Kingdom on September 27, 1825 and railways ushered in the industrial revolution. On the eve of the twenty-first century, railways remain indispensable to the commercial and social life of most countries.

Since the Stockton & Darlington opened its doors in 1825, we have all learned much about safety, and today railways around the world provide, by most measures, the safest and most *environmentally-friendly mode of transport.*

While we have come a long way, the journey is a never ending one. Railway companies, workers and their organizations, government regulators and investigators continue on this journey to improve an already good safety record.

If any country is a railway country, it is Canada. It was the building of railways from Central Canada to the east and west coasts that allowed the Canadian confederation to happen. The railways continue to play an important part in the Canadian economy and Canadian life. Canada's 55 railways are proud of their safety record, but understand that there remain improvements to be made.

It is a privilege for the Railway Association of Canada, its member companies, labour unions and the government of Canada to play host to the Tenth Annual International Rail Safety Conference in Banff, Alberta. We hope the conference will contribute to continuing improvements in rail safety.

We are pleased to welcome delegates and their companions to this conference, and to Banff, Alberta in the beautiful Canadian Rockies.

The organizers have arranged for three days of exceptional papers and presentations, tours of rail facilities, and visits to places of spectacular natural beauty.

We welcome you, and hope that you find the presentations thought provoking, the conversations stimulating and the scenery inspiring.

I look forward to meeting you in Banff.

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Conference Program Agenda

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INTERNATIONAL RAILWAY SAFETY CONFERENCE 1999
BANFF, ALBERTA, CANADA
Tuesday, October 19 - Friday, October 22, 1999

CONFERENCE PROGRAM AGENDA

TIME	FUNCTION	SPEAKER	PAPER / PLENARY	VENUE/COMMENTS
October 19, 1999 1600 - 1900	Registration and Receipt of Documentation			***Curio Foyer***
1900 - 2100	***Welcome Reception for delegates and companions***			***Ivor Petrak Room***
October 20, 1999 **0730 - 0815**	***Continental Breakfast*** Registration for late arrivals/Welcome			***Alhambra Foyer***
0830 - 0845	Opening of Conference/ Welcome Address	R.H. Ballantyne President - The Railway Association of Canada		***Alhambra Room***
0845 - 0915	Presentation	J. Welsby Department of Public Enterprise Dublin - Ireland	New Regulatory Framework for Ireland	***Morning Moderator M. Lowenger RAC***
0915 - 0945	Presentation	L. Hoffman Transport Canada - Canada	Canada's Role in Regulating Railway Safety: A Field Perspective	
0945 - 1015	Presentation	T. Atkinson Land Transport Safety Authority - New Zealand	Railway Safety Regulation in Relation to Tolerable Risk and Best Practice Benchmarking	
1015 - 1045	***Coffee Break***			
1045 - 1115	Presentation	J. de Villiers Spoornet - South Africa	Developing a Rail Safety Regulator for South Africa	

TIME	FUNCTION	SPEAKER	PAPER / PLENARY	VENUE/COMMENTS
1115 - 1215	Plenary Session "A"	V Coleman - UK C Erasmus - South Africa R Matshoge - South Africa	The Role of Government Regulation	***Joint Moderators***
1215 - 1345	***Lunch***			***Rob Roy***
1345 - 1415	Presentation	V. Coleman HM Railway Inspectorate - UK	The Safety Implications of Growth in the Railway Industry	***Afternoon Moderator*** ***M. Tessier*** ***VIA Rail Canada Inc.***
1415 - 1445	Presentation	K Kawano /Y. Kimura East Japan Railway - Japan	Safety Plan 21 - Safety Policy for the 21st Century	
1445 - 1515	Presentation	W.S. Casley Bill Casley Consultants PM Ltd.- Australia	Overview of Safety Considerations for the Construction and Operation of Australia's First Very High Speed Railway	
1515 - 1545	***Coffee***			
1545 - 1615	Presentation	C. Lindahl Swedish National Rail Administration - Sweden	Implementation of a New Traffic Safety Organization	
1615 - 1645	Presentation	M. Maynard London Underground - UK	Safety Review of Organizational Change in London Underground	
1645 - 1715	Presentation	G. Churchill RATP Dep't des Equip. et Sys. Elect. - France	A New Approach to Risk Management at the RATP	
1830 - 2130	***Informal Dinner - Western Night Barbeque for delegates and companions***			

TIME	FUNCTION	SPEAKER	PAPER / PLENARY	VENUE/COMMENTS
October 21, 1999 **0730 - 0815**	***Continental Breakfast***			***President's Hall Foyer***
0830 - 0900	Presentation	J. Schultz CSX Transportation - USA	CSX Transportation's New Compact with Employees: How We Are Changing Safety Culture	***Beatty/Coleman Room*** ***Morning Moderator*** ***F. Ackermans*** ***Canadian Pacific Railway***
0900 - 0930	Presentation	M. Mathebula Spoornet - South Africa	Linking Employee Engagement to Safety Performance: A Human Assets Approach	
0930 - 1000	Presentation	M Papst Consultant - Australia	Psychological Aspects of Rail Safety	
1000 - 1030	***Coffee Break***			
1030 - 1100	Presentation	K. Chiba/K. Tsuru East Japan Railway Worker's Union - Japan	Promotion of Spread of Union's Safety Philosophy	
1100 - 1130	Presentation	T. Secord - UTU - Canada A. Ferrusi - CN - Canada	Joint Initiatives in Health and Safety	
1130 - 1230	Plenary Session "B"	A. Ferrusi/T. Burtch/ G. Hucker - Canada	The Influence of Human Reliability in Safety Performance	
1230 - 1345	***Lunch***			***Baron Shaughnessy***
1345 - 1415	Presentation	D. Edwards National Rail Corporation - Australia	Rail Safety Worker Training, Assessment and Compliance	***Afternoon Moderator*** ***T. Burtch*** ***Transport Canada***
1415 - 1445	Presentation	G. Housch BMWE - Canada	Railway Culture Breaking the Mold	

TIME	FUNCTION	SPEAKER	PAPER / PLENARY	VENUE/COMMENTS
1445 -1515	Presentation	J. Hall NSW Department of Transport - Australia	Change the People or Change the People!	
1515 - 1545	***Coffee Break***			
1545 - 1615	Presentation	A. Ryokawa/T. Matsuda - East Japan Railway - Japan	Evaluation of Safety Activities and Identification of Future Safety Policies Based on the Questionnaire Research to Employees	
1615-1645	Presentation	D. Davis Tranz Rail - New Zealand	A Review of Locomotive Engineers Extended Hours of Service	
1645 - 1715	Presentation	Y. Toyoshima/M. Takahashi East Japan Railway Worker's Union - Japan	Lessons from a Fatal Accident to Subcontracted Workers on Yamate Freight Line	
1830 - 2130	***Formal Dinner for delegates and companions***			***Cascade Ballroom***
October 22, 1999 0730 - 0815	***Continental Breakfast***			***President's Hall Foyer***
0830 - 0900	Presentation	E. McCullough/R. Gnam Transportation Safety Board of Canada - Canada	The Safety Investigator - The TSB Approach to Accident Investigation	***Beatty/Coleman Room*** ***Morning Moderator I. Naish Transportation Safety Board***
0900 - 0930	Presentation	M. Walter Railtrack - UK	Improving Accident Investigation on the UK's Privatized National Railway	

TIME	FUNCTION	SPEAKER	PAPER / PLENARY	VENUE/COMMENTS
0930 - 1000	Presentation	R. Howe Transport Accident Investigation Commission - New Zealand	Rail Accident Investigation - Messages for the Millennium	
1000 - 1030	***Coffee Break***			
1030 - 1130	Plenary Session "C"	R. Howe - New Zealand J. de Villiers - South Africa	Incident Notification - Cooperate or Regulate	***Joint Moderators***
1130 - 1200	Presentation	G-E. Löwer DB Netz AG - Germany	Aspects of Stabilising and Developing Safety in a Railway System, an Enhanced Approach to Railway Safety	
1200 - 1315	***Lunch***			***Baron Shaughnessy***
1315 - 1345	Presentation	J. Kam MTR Corporation - Hong Kong	Safety Assurance for New Extension Projects of the Hong Kong MTR Corporation	***Afternoon Moderator*** ***C. Hick*** ***RAC***
1345 - 1415	Presentation	F. de Jouvencel SNCF - France	Risk Management as Applied to the Carriage of Dangerous Goods on SNCF	
1415 - 1445	Presentation	H. Ring Swedish National Rail Administration - Sweden	Managing Safety Cost Models	
1445 - 1515	***Coffee break***			
1515 - 1545	Presentation	G.A. Smallwood Burlington Northern Santa Fe - USA	Managing Safety in Mergers and Divestitures	

TIME	FUNCTION	SPEAKER	PAPER / PLENARY	VENUE/COMMENTS
1545 - 1615	Presentation	C. Erasmus/R. Matshoge Metrorail - South Africa	Safety Standards for Training of Train Drivers in Metrorail	
1615	**Closing Remarks - Farewell**	**R. H. Ballantyne**		
Stand-by Paper		A. Pretorius Spoornet - South Africa	Towards Safe Norms in Train Control Systems	

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COMPANIONS PROGRAM

Lake Louise Sightseeing Tour with Lunch at the Chateau Lake Louise

Day 1 Spousal Program, October 20

A scenic drive takes guests from the baronial Banff Springs Hotel, past the Vermilion Lakes, spotted with beaver lodges, and along the Trans Canada Highway. Traveling northwest, the tour follows the Bow River upstream past spectacular mountain views of the Sawtooth Range and Castle Mountain, and past the pine-forested slopes of the Pipestone Range.

The tour will then reach the awe-inspiring Chateau Lake Louise, which is situated on the shores of lovely Lake Louise and framed by the majestic Victoria Glacier. Lunch will be served in the Poppy Room, supplying a savoury lunch and stunning views of the lake and surrounding peaks.

The guests will have time to sit back and enjoy the picture-perfect setting or take a walk on one of the many hiking paths near the lake before the coach return.

Departure Time **12:00 P.M.**
Return Time **5:00 P.M.**

Exploring Banff's Galleries and Shops

Day 2 Spousal Program, October 21

Participants will enjoy a chance to explore some of Banff's local galleries and artisan shops,. This tour will provide guests with the opportunity to discover the flavours of Banff.

Transportation will be provided from the hotel to the townsite, where a knowledgeable guide will lead the group through some of the "hot spots" in town, for both shopping and art viewing. The guide will provide informal lectures at the galleries and be open to answer any questions that guests may have.

A walk down Banff Avenue will then bring guests to the popular western Canadian restaurant of Earl's, for an appetizing meal.

Return shuttle transportation will occur after three hours, in order to allow free time in town for everyone to browse the shops.

Departure Time **10:00 A.M.**
Return Time **1:00 P.M. / 1:30 P.M. / 2:00 P.M.**

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New Regulatory Framework in Ireland

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NEW REGULATORY FRAMEWORK FOR IRELAND

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SYNOPSIS

The statutory mechanisms which, augmented by established custom and practice, form the basis of governmental monitoring of railway safety in Ireland (IRL) can no longer be considered fit for purpose. A need exists for the development of a new regulatory framework which is appropriate to the current operational railway environment and can accommodate the technical and administrative developments which are likely to occur in the short to medium term.

This paper outlines the historical background to this situation, assesses the resultant impact on existing levels of railway safety and the allied culture and draws comparisons with other countries. Factors which are external to, but impact to a greater or lesser degree on, railway safety are assessed and other internal and external regulatory pressures considered. The results of a recent comprehensive review of railway safety in IRL are presented with particular reference to possible future regulatory scenario's and conclusions drawn as to the most appropriate way forward.

HISTORICAL BACKGROUND

System and operations

The development of railways commenced in Ireland in the mid 1900's and by the turn of the century the network encompassed most provincial towns with few parts of the country more than 20km (12 mls.) from a station (Appendix 1). As late as 1947 there were still in excess of 3600 route kilometres (2250 mls.) of railway but with the advent of cheap road transport the network halved in size over the following twenty years. The current system extends to approximately 1900 route kilometres (1060 mls. comprising primarily a series of radial routes centred on Dublin and serving provincial towns/cities (Appendix 2). The principal feature which distinguishes IRL's railway system from those elsewhere in Europe is it's wider gauge of 1575mm (5' 3"). More extensive system details are given in Appendix 3.

At the operational peak in the early 20c. 4 major and 15 minor railway companies operated passenger and freight services on the standard gauge network with a further 12 operating local services on a variety of narrow gauge lines, primarily 914mm (3' 0"). By 1925 the four major standard gauge railways amalgamated under one operator, the Great Southern Railway Company (GSR) which also absorbed all the minor standard gauge and 9 of the narrow gauge companies. In 1945 the GSR joined the Dublin United Transport Company to form Córas Iompair Éireann (CIE) which in turn was nationalised in 1950[1] becoming the state owned transport operator. While a number of the minor narrow gauge railways continued to operate under private ownership post nationalisation the last of these ceased operation in the 1960's. In 1986 [2] CIE became the parent holding company under which three independent operating companies were established, two responsible for bus operations in the greater Dublin area and elsewhere throughout the country respectively and the third, Iarnród Éireann (IE) for railways.

Administration

From the commencement of railway development until 1921 the whole island of Ireland was under British administration and consequently common legislation applied to all aspects of railway development and operation including inspection and approval. With Irish independence in 1921 the associated acts, being principally the Regulation of Railways acts 1840 to 1889 were, along with a wide range of other legislation, adopted into national law en bloc. Though in the United Kingdom this early railways legislation has since been updated and consolidated this has not been the case in IRL where, with minor additions, it remains the basis for governmental monitoring of railway safety.

Regulation

Towards the end of the 19c. attention began to focus on the safety of railway employees in the context of such as excessive hours of duty, powers being established [3] to both hear complaints and require the adoption of 'reasonable' worked hours. In 1900 [4] the regulator was given powers to require railways to use 'plant or appliances' which might increase employee safety or conversely to cease such usage where this had proved dangerous. This same legislation provided for the making of rules regarding dangerous railway operation which were subsequently promulgated in 1902. Railways are also subject to general legislation of 1989 [5] which provides for the safety, health and welfare of employees.

Basic powers of inspection of infrastructure and rolling stock were established in 1840 [6] and extended in 1871 [7] to include all new lines. At the same time accidents which were to be notified to the regulator were defined and procedures established for the holding of formal investigations and inquiries into accidents.

On 12th June 1889 [8] an heavily laden passenger excursion train which was unable to negotiate a severe gradient near Armagh was divided to enable it to proceed in portions. Unfortunately however the rear section was inadequately secured and ran back down the incline colliding with a following passenger train resulting in the death of 78 passnegers and injuring a further 260. This disaster led to legislation which established three fundamental principles of railway working on a statutory basis [9] namely the absolute block system, the interlocking of points and signals and the equipping of trains with a continuous automatic brake.

Railway safety legislation in IRL is based on the principles that operational safety, including the maintenance of infrastructure and rolling stock to adequate standards, is the responsibility of the railway company and that government cannot be held responsible for the safety of structures designed and built by the railway. This fundamental operator responsibility for safety was established in statute in 1958. [10]

Standards

In the absence of national railway technical standards it has been the practice for Ireland to informally adopt those of other countries which it sees as representing 'best practice' in the context of the Irish environment. Given the common legislative and industrial roots this has for the most part meant those of Britain know colloquially as the 'blue book' which in 1996 moved from the prescription of technical standards [11] to setting associated goals accompanied by the provision of advice on how these might be met. [12] Guidance has also been taken from the standards from other European countries. [13]

Inspection

While on the formation of the state IRL was able to adopt British legislation it lost the associated administrative support previously provided from London and had to make specific provision in the appointment of it's own Railway Inspecting Officers (RIO) who operate within the government ministry with responsibility for public transport, currently the Department of Public Enterprise (DPE). Since 1921 six individuals have held this position for various consecutive periods. Under statute the responsibilities of the RIO are limited to the ;

- receipt of specific accident information and reporting on same,
- approval of new and substantively modified infrastructure works,
- carrying out public inquiries into railway accidents and
- approval of the Dublin light rail transit system. [14]

A range of other duties accrue to the position including the provision of technical advice within the DPE.

CURRENT LEVELS OF SAFETY

In comparative terms the railway network in IRL is small and the majority of the system relatively lightly trafficked. While historically comprehensive accident records have been kept the data set is small and meaningful statistical analysis difficult. Attempts therefore to isolate trends in relation to particular accident types are typically frustrated in the medium/long term by the random occurrence of single significant events. Notwithstanding such statistical shortcomings effective international comparisons will always subjet to difficulties in normalising data from various sources each of which has it's own unique blend of national characteristics relating to demographics, economic activity, infrastructure density, culture etc.

One indication of how well, in the absence of rigorous independent regulation, IE has met it's fundamental duty of care lies in the fact that the limited statistics fail to indicate any catastrophic deterioration in safety levels and published international data [15] indicates that on average IRL's railway safety is comparable with that of it's European neighbours. None the less given the small statistical base there were concerns about the implications of near misses, the majority of which go unrecorded. Also, conscious of falling service quality due to lack of investment, there were further concerns that the establishment of a quasi self regulatory environment which was not supported by the implementation of a comprehensive and auditable system of safety management had led to development of a false level of confidence in safety standards. There was also a belief that as a result shortcomings in safety culture exisited and a lack of understanding or appreciation of the risks associated with many day to day operational tasks..

REVIEW OF RAILWAY SAFETY

Consequently in 1998 the Government commissioned a comprehensive review of railway safety in IRL [16] including an assessment of the current safety regulatory regime. The study identified significant deficiencies in a number of areas. In particular it confirmed the concerns of shortcomings in safety management and culture and of the inevitable physical deterioration of assets due to years of under-investment. An extensive programme of physical works and management cultural change were recommended culminating in the approval by Government of a £430m safety investment programme for the period 1999-2003. To put this in context railway infrastructure investment for the five year period 1990 and 1994 was £180m. The study also considered various future regulatory scenarios recommending what was seen to be the most suitable option.

Approval/Inspection/Investigation/Enforcement

An anomalous situation exists in that the requirement for railways to obtain approval for new works excludes the key area of signalling and communications and does not apply at all with respect to rolling stock. While by custom and practice there is generally consultation between IE and the RIO where such works are to be commissioned, there has been an unacceptable lack of consistency and clarity in the application of such agreed procedures. The situation overall has been exacerbated by an ongoing failure to commit adequate resources to the RIO function.

A strict interpretation of the law restricts the RIO to carrying out inspections for those purposes specifically directed by the Minister, namely new works approvals or the investigation of major accidents which typically occur only once in 10 years. Similarly the RIO has no personal power of veto and can only take enforcement action indirectly by making recommendations to the Minister who may in turn direct the railway to act accordingly. However, as with custom and practice in relation to the scoping of new works approvals a practical approach is taken where the direct intervention of the RIO in operational railway matters on a day-to-day basis, both proactively and reactively, is accepted by IE which generally acts on any associated recommendations made. While this approach might be pragmatic it is strictly speaking outside the law.

With regard to the majority of accidents where investigation or public inquiry at the specific direction of the Minister is inappropriate IE, while under no obligation to do so, has traditionally forwarded copies of it's own internal inquiry reports to the RIO who has used the appended transcripts of evidence as the basis for his own assessment. Such a procedure however lacks true independence and, since it relates to only approximately 10% of annual reported accidents, fails to give a comprehensive insight into the overall 'health' of the railway.

Accident Reporting

Inconsistencies exist between the type of accident which IE are statutorily required to report to the DPE and those which must be reported to the Health and Safety Authority (HSA), the latter involving a much coarser threshold. Independent of the resultant administrative burden on IE this means that the accident statistics utilised by the DPE are out of step with the rest of industry and any resultant conclusions drawn may not bear comparison.

Safety Health and Welfare

While in the United Kingdom Her Majesties Railway Inspectorate was placed under the umbrella of the Health and Safety Executive in 1989 their equivalent bodies in IRL, the DPE and HSA, remain separate. Though they have largely independent responsibilities a situation where IE is faced with two safety regulators is unsatisfactory, particularly where these operate within different government departments and have limited interaction. In practical terms the resultant duplication which such division brings is wasteful, particularly of scarce human resources, and illogical in that in addressing any safety issue comprehensively it is impossible for either inspectorate to do so with reference to its specific area of responsibility only.

Resourcing

Under resourcing of railway inspection in IRL has become particularly problematic in recent years with an increasing backlog of work developing which has effectively kept the RIO desk bound. The resultant lack of capacity to carry out proactive inspections has made it difficult for the RIO to gain an adequate appreciation of the day to day safety management of the railway and resulted in a low awareness on the railway of a regulatory presence. A number of factors including steady growth in the industry, particularly following a long period of inadequate funding, and greater expectation of accountability are exacerbating this situation. A sole RIO also presents two fundamental problems, there is no environment in which to share/discuss technical issues and no fall back during period of absence due to such as sickness/holiday.

Suggested regulatory scenarios

The independent consultants suggested five options for future safety regulation;

a) A zero option where the DPE divests itself totally of all safety regulatory responsibility would clearly be counter to international trends across all transport modes and throughout industry as a whole.

b) Maintenance of the status quo would resolve none of the current shortcomings and anomalies and mean the continuance of the existing unacceptable situation.

c) While it was considered that the creation of a single dedicated railway inspectorate within the HSA would resolve many of the current problems such restructuring was considered too radical and would also deprive the DPE, which has responsibility for overall transport policy, of ready access to railway safety and technical advice

d) The formation of a single inspectorate within the DPE by the importation of related responsibilities currently vested in the HSA would equally resolve some of the current significant shortcomings and be less radical. It would however fail to address the significant question of conflict of interest where the DPE would continue to be both the railway 'owner' and safety regulator.

e) The formation of a transport safety agency incorporating a railway inspectorate offers many advantages not least of which would be public confidence in the independence of the safety regulator. In terms of restructuring and legislative change it would however be the most radical option.

The report considered that while option (e) was likely to present the most logical long term choice a pragmatic assessment indicated that the balance of advantage lay with option (d). Such a choice would however be contingent on the harmonising of accident reporting between the DPE and HSA, formal vesting of appropriate HSA powers in the RIO, removal of investigation/approval anomalies/inconsistencies and the allocation of appropriate resources to the railway inspectorate.

NATIONAL CONSTRAINTS

Geography/demography

The island status of IRL places limitations of the nature of the railway system which themselves impact on associated regulation. While there is a steady growth in population it is unlikely that the existing demographic structure of a single major conurbation of Dublin within a largely rural and sparsely populated environment will change significantly. Equally therefore though the railways are currently enjoying steady growth it seems likely that, with the exception of Dublin LRT and suburban rail developments, the market for rail transport will not change dramatically and that existing levels and patterns of service will continue into the foreseeable future. Allied to this is the effective constraint imposed by the physical size of the country and resultant proximity of major inter city nodes. Maximum journey lengths in the order of 250km (155 mls.) and services typically incorporating intermediate stops suggest that the development of high speed routes would not be economically justified. As the construction of an external high speed link to Britain also appears improbable it is unlikely that the inspectorate will have to address the associated technical and safety issues.

Technical capacity

The scale of railway operations in IRL can only justify the establishment of a relatively small inspectorate within which it will not be possible to develop the levels of in house expertise and experience found in larger organisations or indeed in the railway itself. In such a situation the advice of colleagues in other inspectorates has proved invaluable in which regard the help of successive Chief Inspectors of Railways in Britain and their staff must be acknowledged. More recently reliance has also been placed on independent third party assessment in the form of safety studies and the application of acknowledged tools such as risk, fault tree or failure modes analyses.

Administrative resources

In general terms national administrations suffer diseconomies of scale roughly in proportion to their population since the resources required for such tasks as the drafting of legislation are largely independent of size. With a population of only 3.8m such pressures are particularly acute in IRL and have undoubtedly contributed to the shortcomings of the current regulatory framework. Following the review of railway safety a commitment has been given to update and consolidate railway safety legislation but it is unlikely that IRL will be in a position to develop national technical railway standards and will continue to piggy-back on those of other countries. In doing so however it is desirable that any revision of legislation give some level of formal recognition to the procedure.

Legislative void

A significant result of the failure to update railway legislation to reflect current technology and operating environment has been the filling of the resultant void by the courts in establishing legal precedent. In IRL the rights of the individual are heavily enshrined in the constitution [17] and historically the legal system has leaned heavily in their favour. In the context of railway operations this is graphically illustrated by the heavy duty of care which leaves them responsibly for the mitigation of a high proportion of imported risk even where this results from malicious or irrational actions outside their direct control. [18] A similar though apparently less onerous responsibility has been recognised in Britain. [19] While the modernising of railway legislation will not impact on constitutional rights it would leave railways in a better position to manage safety effectively.

Northern Ireland

IE jointly operates a cross-border passenger services with it's Northern Ireland (NI) counterpart, Northern Ireland Railways, and independently operates cross-border freight services. In the context of current political initiatives in NI the potential for the establishment of a common railway inspectorate has been considered, there seeming to be significant advantage in putting the informal working relationship which currently exists between the two bodies on a firmer footing. While the proposed Executive excludes a transport ministry there will undoubtedly be initiatives in this area and the potential for these encompassing railway safety should be a consideration in developing a new regulatory framework.

EUROPEAN UNION/INTERNATIONAL INFLUENCES

European Union (EU) directives

Under EU railway open access policy Member States are currently required to provide for third party access to their respective networks [21], for the licensing of infrastructure providers [22] and the certification of operator competence. [23] Technical standards for interoperability (TSI) which will facilitate seamless train operation over the various signalling and electrification systems of the European High Speed Rail Network (EHSRN) are being developed .[24] Though by virtue of its non-standard gauge and lack of trans-boundary hard rail link IRL currently enjoys derogation from technical requirements this might not remain so as possible extension of these provisions to regional routes has already been proposed. Notwithstanding national application of TSI's IRL must address the issue of nominating a notified body for type-approving equipment which might be manufactured in Ireland for use on the EHSRN.

To date, with the exception of very general safety provisions in specific Directives, the EU has not involved itself in general railway safety regulation. It seems unlikely however that this will remain the case. A working group of the European Transport Safety Council (ETSC) which receives financial support from the EU recently published a briefing note [25] which concluded that a more active EU involvement in railway safety was necessary. A more exhaustive study of the various railway safety regulatory regimes in Member States commissioned directly by the EU [26] has now commenced.

Portability of technology

In addition to the EU driving the liberalisation of previously nationally focused rail industries there is a general world wide opening up of the market place with railways sourcing equipment globally. For railways and their regulators from whom requisite approvals will be sought many suppliers are unknown quantities without a proven track record and effective means of certification must be found. For each country to tackle this task independently would be both onerous and wasteful since there may be comparable competent authorities in other countries who have already conducted the exercise or for whom the technology is not new or novel. For safety regulators this raises the question of management of mutual acceptability of approval.

Privatisation

IRL has the highest percentage employment in the public sector of any EU country. While some industries, including CIE, are 'semi-state' or state owned companies with boards of directors and operating in a quasi private manner they remain essentially within governmental control. In July of this year the first such company, operating in the telecommunications sector, was privatised with every likelihood that others will follow reflecting the global trend. Were this to include CIE and/or it's railway subsidiary IE the associated safety regulatory regime would have to be capable of effectively accommodating the change.

Independent monitoring

The current situation where the DPE is the 'owner' of the railway, provides the legislative framework within which it operates and is responsible for monitoring associated safety is becoming increasingly unacceptable. While a continuance might be accepted in the short term there will undoubtedly be pressure, if not a formal requirement in the form of an EU Directive, to establish an independent safety agency. However, within the DPE the role of the RIO includes the provision of technical advice on both light and heavy rail issues and the retention of this facility would result in an undesirable division or duplication of human resources.

SOCIAL CHANGE

Public expectations

As elsewhere there has in IRL been a significant growth in public awareness in recent years of environmental, health and safety issues and a greater expectation that appropriate protective measures are being implemented. Safety regulators are being held increasingly accountable for their stewardship and the demand for transparency makes it essential that through the associated structures and regimes they are able to demonstrate adequate standards are being achieved. As yet railway users in IRL do not have a collective voice but it seems inevitable that this will happen in the short rather than long term and will place additional pressures on both the railway operator and the regulator.

Freedom of Information

Freedom of information (FOI) legislation came into force in IRL in April 1998 [20] which, with limited exceptions, places all documentation held on government files in the public domain. Though guidance is given as to what information may be withheld the final decision lies with an independent commissioner who must decide whether the document in question falls within a specified category or the balance of favour lies in disclosure. In this regard IE, to whom the FOI act does not apply, consider that their internal inquiry reports contain sensitive information the disclosure of which might compromise the effectiveness of the whole inguiry process by taking it into a quasi judicial mode. Accordingly, in the absence of the RIO being able to give any guarantee of their not being disclosed the forwarding of these reports to him under established custom and practice has now ceased and an alternative investigative procedure will have to be sought.

Criminal negligence

There is a growing eagerness on the part of law enforcement agencies in some jurisdictions to pursue prosecutions for criminal negligence arising from railway accidents. In such situation the process of public inquiry by the safety regulator effectively becomes sub-judicy undermining the fundamental philosophy of establishing the facts, identifying the causes and recommending actions to prevent recurrence as expeditiously as possible. While this situation has not manifest itself thus far in IRL it would be desirable that any new regulatory framework include an effective means of dealing with the issue should it arise in the future.

CONCLUSIONS

An effective regulatory regime must meet a number of basic requirements.

1) It must provide Government, and through it the public as a whole, with an effective means of ensuring that adequate levels of safety are met in the construction and operation of railways.

2) There must be an adequate balance between fundamental methodologies adopted and the human and financial resources allocated such that the primary objective can be met. In this context it should be remembered that railway inspection is itself a safety critical task.

3) The adopted regime should be seen to be impartial, independent and transparent in which regard it should adequately address the potential conflicts of interest which exist between ownership/service provision, regulation and investigation.

4) It should be sufficiently adaptable and flexible to accommodate technological and operational change and, in so far as is necessary, administrative and political change.

These requirements should be met in each of the inspectorates major functional areas, in IRL's case the approval of new works, monitoring of operational safety and the investigation of accidents

New works approvals

Currently in approving new works the RIO focuses on safety issues unique to the particular development including the construction/commissioning process and assimilation into the overall railway operating environment. In the context of detailed design and specification the onus is placed on IE to adopt best industry practice and to verify compliance with same. A further development of this approach appears to offer the best advantage since by requiring the railway to demonstrate that adequate standards of safety have been met the RIO effectively exports the major part of the associated workload. In formalising the process however it's scope of application will require definition free of ambiguity or anomaly. The question of competency to certify compliance will also have to be addressed. At present this is left to the particular 'expert' in IE with no formal process of notification to the RIO. To be effective such certification will have to be carried out by an independent party with no vested interest in the railway and be accompanied by an adequate paper trail.

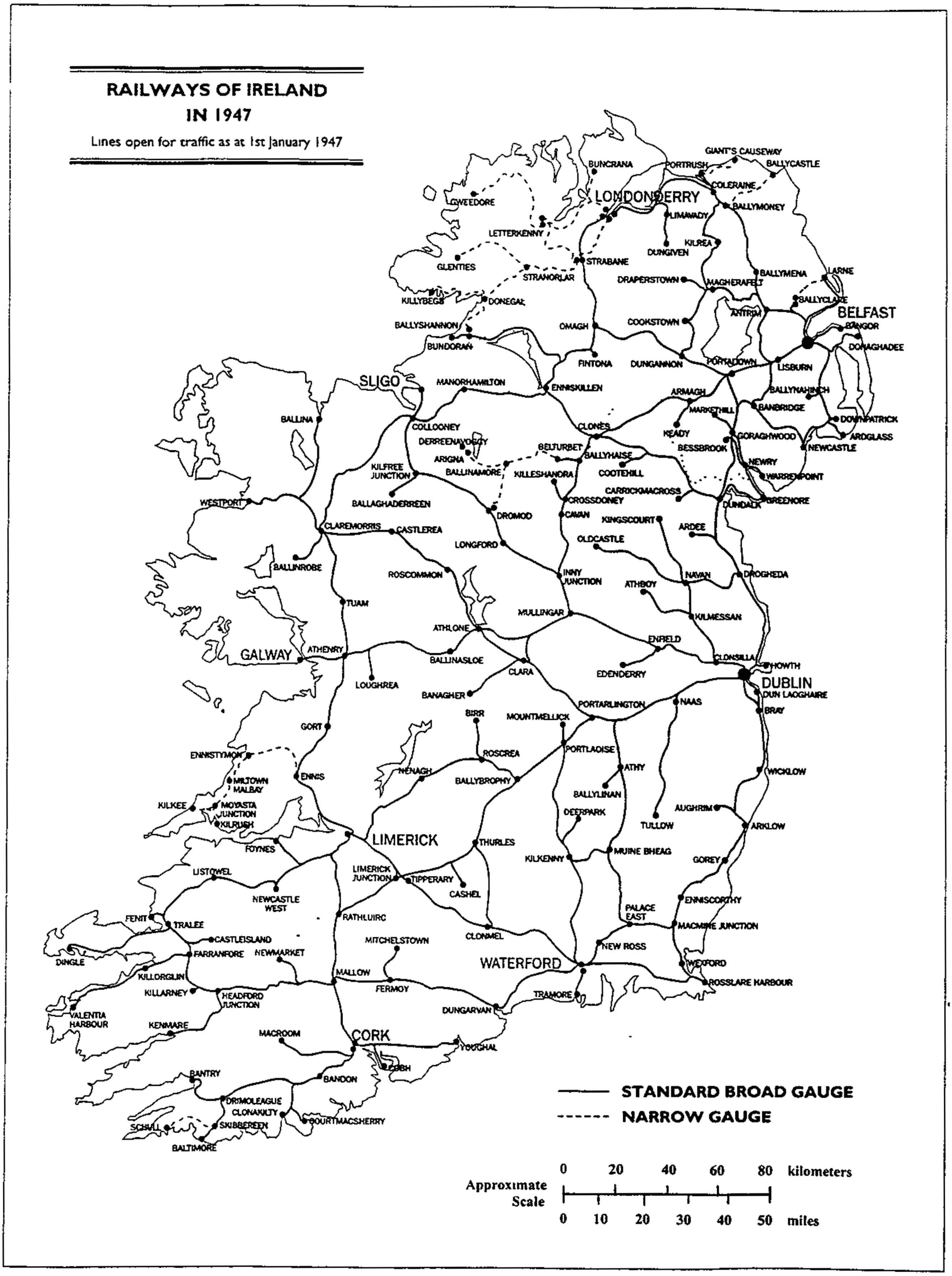
Operational safety

With regard to assessment of operational competency and monitoring of safety IRL must, irrespective of how it chooses to deal with IE, make provision in respect of accommodating third party access to the railway network. The EU requires that this process should be impartial and not favour nationally based companies and in the interests of transparency it is logical that the same procedure be applicable to all operators. While IE has adopted tools such as the International Safety Rating System and in specific instances commissioned various independent risk analyses the 1998 safety review highlighted the absence of a comprehensive documented approach to safety management. An associated programme has now been initiated and work is well advanced on the formulation of company standards and procedures. This work forms the foundation for a 'safety case' which would require operators to go through a rigorous process of the identification, quantification and mitigation of risk in a structured and auditable manner. IRL has no contemporary experience of tramways and in the context therefore of the current Dublin LRT project a safety case which can be developed in parallel with the approvals process appears to be an appropriate method of demonstrating operator constancy. From pragmatic viewpoint this is advantageous since again it exports the responsibility to demonstrate safety, and with is the allied workload, to the operator allowing the RIO more time for proactive inspection. In establishing a legislative framework for the preparation and acceptance of safety cases the experience of other countries where they are currently in operation can be taken into account.

Accident investigation

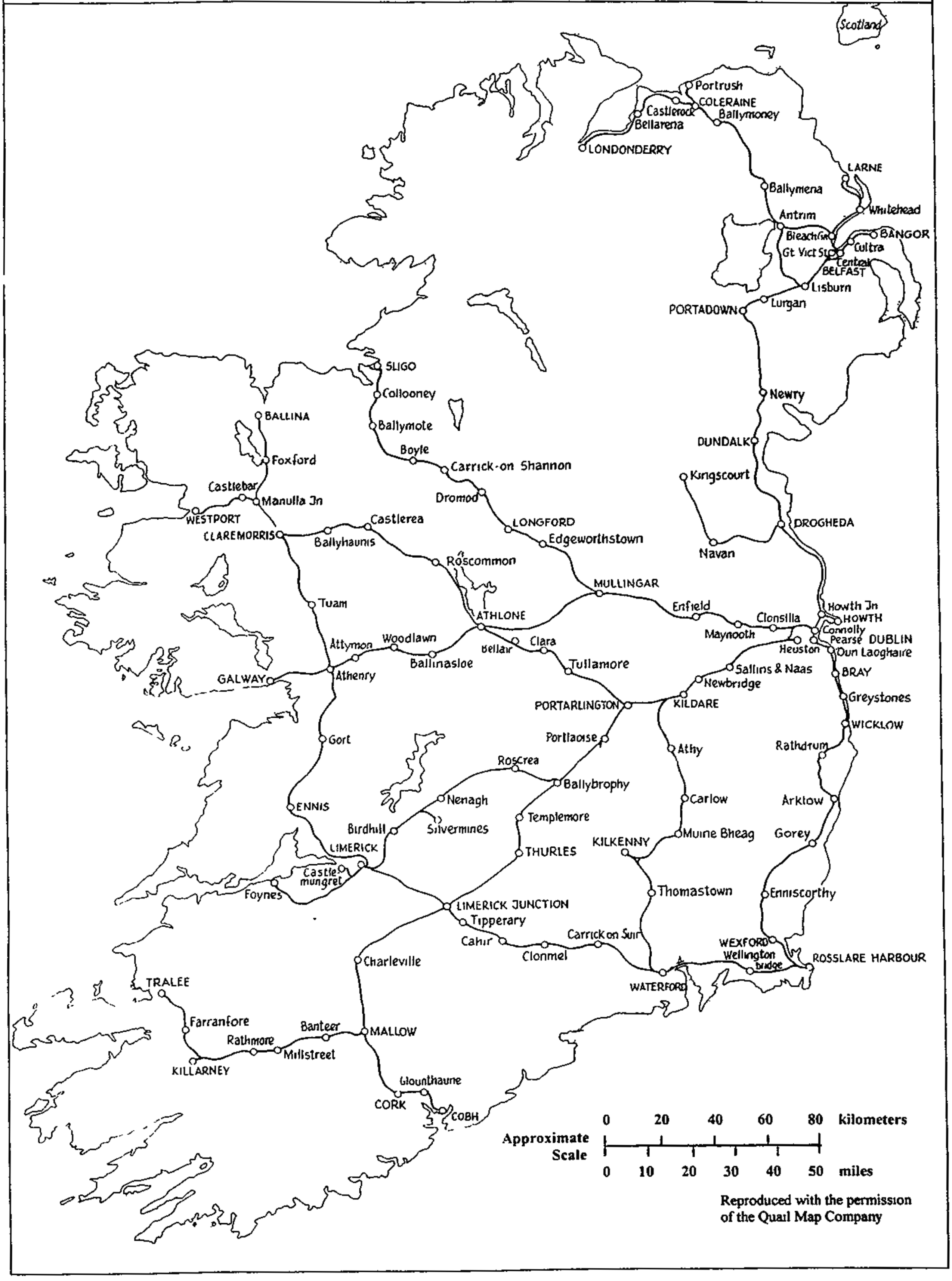
The recommendation of the independent review of railway safety that an additional two RIO's be recruited has been accepted and their appointment is expected in Septemebr/October. In addition to addressing the under-resourcing issue this will also resolve the difficulty of lack of cover during periods of absence but the question of independence and conflict of interest remains. The consultants preferred, though for pragmatic reasons not recommended, option appears to provide the best solution that is the establishment of a cross-modal transport safety body. Successful models have existed in North America for many years and more recently other countries taking this direction. For smaller countries like IRL particularly there are potential synergies in grouping small independent investigation bodies as currently exist in the aviation and marine sectors, the former in the DPE and latter in the Department of the Marine and Natural Resources.

In general terms a move to a requirement for the developer/operator to demonstrate compliance/competence in terms of international standards and industry best practice appears the sensible choice as it affords the best use of scarce resources, offers the flexibility to accommodate industry and regulatory change and follows the philosophy already adopted in other sectors both at home and abroad. It also has the significant advantage of requiring the railway to establish a rigorous and auditable process of risk assessment and mitigation. While however an associated inspectorate might have the technical capacity to investigate railway accidents the probability is that in the interests of independence and transparency this will have to be a separate function best provided for in a single cross-modal body.


RAILWAYS OF IRELAND
IN 1947
Lines open for traffic as at 1st January 1947
GIANT'S CAUSEWAY
BALLYCASTLE
PORTRUSH
BUNCRANA
COLERAINE
LONDONDERRY
BALLYMONEY
LIMAVADY
GWEEDORE
LETTERKENNY
KILREA
DUNGIVEN
STRABANE
GLENTIES
STRANORLAR
DRAPERSTOWN
MAGHERAFELT
BALLYMENA
LARNE
BALLYCLARE
KILLYBEGS
DONEGAL
ANTRIM
BELFAST
BALLYSHANNON
OMAGH
COOKSTOWN
BANGOR
BUNDORAN
DONAGHADEE
FINTONA
DUNGANNON
PORTADOWN
LISBURN
SLIGO
MANORHAMILTON
ENNISKILLEN
ARMAGH
BALLYNAHINCH
MARKETHILL
BANBRIDGE
BALLINA
COLLOONEY
CLONES
DOWNPATRICK
KEADY
GORAGHWOOD
ARDGLASS
DERREENAVOGGY
BELTURBET
BESSBROOK
NEWCASTLE
ARIGNA
BALLYHAISE
NEWRY
KILFREE JUNCTION
BALLINAMORE
KILLESHANDRA
COOTEHILL
WARRENPOINT
CARRICKMACROSS
BALLAGHADERREEN
CROSSDONEY
GREENORE
WESTPORT
DUNDALK
DROMOD
CAVAN
KINGSCOURT
ARDEE
CLAREMORRIS
CASTLEREA
LONGFORD
OLDCASTLE
BALLINROBE
ROSCOMMON
INNY JUNCTION
NAVAN
DROGHEDA
ATHBOY
TUAM
MULLINGAR
KILMESSAN
ATHLONE
ENFIELD
GALWAY
ATHENRY
BALLINASLOE
CLONSILLA
HOWTH
CLARA
EDENDERRY
DUBLIN
LOUGHREA
BANAGHER
DUN LAOGHAIRE
PORTARLINGTON
NAAS
BRAY
BIRR
MOUNTMELLICK
GORT
ROSCREA
PORTLAOISE
ENNISTYMON
NENAGH
ATHY
MILTOWN MALBAY
ENNIS
BALLYBROPHY
WICKLOW
BALLYLINAN
KILKEE
MOYASTA JUNCTION
KILRUSH
DEERPARK
AUGHRIM
TULLOW
ARKLOW
FOYNES
LIMERICK
THURLES
KILKENNY
MUINE BHEAG
GOREY
LISTOWEL
LIMERICK JUNCTION
TIPPERARY
CASHEL
NEWCASTLE WEST
ENNISCORTHY
PALACE EAST
FENIT
TRALEE
RATHLUIRC
MACMINE JUNCTION
CASTLEISLAND
MITCHELSTOWN
CLONMEL
DINGLE
FARRANFORE
NEWMARKET
NEW ROSS
WATERFORD
WEXFORD
KILLORGLIN
MALLOW
ROSSLARE HARBOUR
KILLARNEY
HEADFORD JUNCTION
FERMOY
TRAMORE
VALENTIA HARBOUR
DUNGARVAN
KENMARE
MACROOM
CORK
YOUGHAL
COBH
BANTRY
BANDON
DRIMOLEAGUE
CLONAKILTY
COURTMACSHERRY
SCHULL
SKIBBEREEN
BALTIMORE
STANDARD BROAD GAUGE
NARROW GAUGE
Approximate Scale
0 20 40 60 80 kilometers
0 10 20 30 40 50 miles

APPENDIX 2

Railway Map of Ireland



APPENDIX 3

Railway System in Irish Republic.

Gauge	1600mm (*5'3"*) adopted in 1843
Route	1900 km (*1,100 miles*) of which 415km (*250 miles*) are double track, primarily the Cork/Dublin/Belfast corridor.
Operations	Inter city on eight primary routes centred on Dublin, suburban serving the greater Dublin commuter belt and to a minor extent other provincial cities, urban rapid transit (*DART*) along the Dublin coastal margin.
Track Standard	54kg/m UIC CWR, currently 50% of the system with target of 90% in 2003 including all passenger lines.
Signalling/control	50% lower quadrant semaphore/conventional block 7% colour light with local control 4% colour light/CTC (Dublin based) 39% colour light/CTC/CAWS 4% colour light/CTC/ATP (*DART*) *(Above %'s track based Currently 90 % of passenger traffic falls within the last two categories and this will rise to 97% by 2003).*
Level crossings	2100 in total with 290 on public roads, 40 of which are fully automated.
Bridges	1080 over the railway, the majority dating from the late 19c. 1670 under the railway, again the majority dating from the late 19c. and of the 400 which span roads 75% are height restricted.
Rolling stock	113 locomotives 300 passenger carriages, predominantly buckeye coupled 40 (*2 x car*) EMU's 30 (*2 x car*) DMU's 2500 freight wagons
Speed	160 km/hr (*100 mph*) Dublin/Cork) subject to 145km/hr (*90 mph*) Dublin/Belfast) local 110km/hr (*70 mph*) generally elsewhere) restrictions
Axle load	18 tonnes with some route restrictions
Passengers	32m passenger journeys) 80,000 daily DART journeys) 1998 5m tonnes)

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ABREVIATIONS and ACRONYMS

ATP	Automatic Train Protection
EHSRN	European High Speed Rail Network
EMU	Electric Multiple Unit
EU	European Union
CAWS	Continuous Automatic Warning System
CTC	Central(ised) Traffic Control
CIE	Córas Iompair Éireann (*Sate owned transport holding company*)
CWR	Continuous Welded Rail
DART	Dublin Area Rapid Transit
DPE	Department of Public Enterprise (*Government department with responsibility for railways*)
DMU	Diesel Multiple Unit
ETSC	European Transport Safety Council (*Independent transport safety lobby group funded in part by Directorate General VII of the EU and part by industry*)
GSR	Great Southern Railway Company
HSA	Health and Safety Authority
IE	Iarnród Éireann (*State owned railway company, subsidiary of CIE*)
IRL	Ireland
LRT	Light Rail Transit
RIO	Railway Inspecting Officer
TSI	Technical Standard for Interoperability
UIC	Union International des Chemins de fer (*International Union of Railways*)

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Ms Linda Hoffman

Canada's Role in Regulating Railway Safety: A Field Perspective

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BIOGRAPHY
LINDA HOFFMAN

Linda Hoffman was born in Ottawa, Ontario. After graduating with a Masters of Science Degree from the London School of Economics and Political Science in England, she joined Systems Dimensions Limited (SDL)in 1973 as a Management Consultant.

From 1976 to 1988 Linda held progressively more senior positions in the Management Board of Cabinet and five other Provincial Government Departments. In these various roles, she had notable successes in advising organizations on planning for the future, on implementing changes, and on modifying organizational structures to achieve new requirements.

In her current position as a Regional Director in the Federal Department of Transport Canada, Linda leads a team of specialists in implementing programs to ensure safe railway operations and safe transport of dangerous goods by road and rail, in the Province of Ontario. This regulatory role involves working in partnership with many stakeholders to implement the *Railway Safety Act*, the *Transportation of Dangerous Goods Act*, and the occupational health and safety requirements found in the *Canada Labour Code Part 11* for on board train crews. Her office is involved in a wide range of activities from monitoring safety of railway track, operations, and rolling stock to monitoring tank truck retest facilities, and responding to dangerous goods incidents and train crews' refusals to work. Linda also provided extensive input to the recent modifications to the *Railway Safety Act*.

CANADA'S ROLE IN REGULATING RAILWAY SAFETY: A FIELD PERSPECTIVE

PRESENTED TO THE 1999
INTERNATIONAL RAIL SAFETY CONFERENCE
BANFF, ALBERTA
OCTOBER 19-22, 1999

Linda Hoffman
Regional Director Ontario Region
Transport Canada

CANADA'S ROLE IN REGULATING RAILWAY SAFETY: A FIELD PERSPECTIVE

Good morning. I am delighted to be here today to describe the Canadian Government's role in regulating railway safety from the perspective of managing a field office. As the Director of Transport Canada's Ontario field office for over a decade, I have seen many changes that have moved us to a more modern and to a more effective regulatory body. Over these years, our goal has remained the same; the protection of life, health, and the environment. What has evolved is how we accomplish this goal. Today Transport Canada provides the leadership and sets the framework whereby the railways and other stakeholders are responsible for achieving a desirable level of safety. Then we play a kind of safety watch-dog role. This role is the first topic I will address today. Secondly, I will highlight some key safety issues in Ontario. Next, I will highlight the importance of the new Safety Management System provision in the *Railway Safety Act*. And I will close with some personal observations on railway safety from a field perspective.

The Ontario Region of Transport Canada represents one of five field offices throughout Canada that administers three distinct pieces of legislation and associated regulations or rules: the *Railway Safety Act*, the *Transportation of Dangerous Goods Act*, and *Part 11 of the Canada Labour Code.* These safety requirements are developed principally at our headquarters in Ottawa. Then we in the field offices ensure industry conformance.

The *Railway Safety Act* has just been recently amended to encourage further railway responsibility and accountability for managing safety. These amendments augment the regulatory philosophy adopted in 1989 whereby prescriptive and detailed regulations including pre-approvals for construction of railway lines were replaced by more flexible regulations and rules which placed the onus on the railways to manage safety.

Our jurisdiction under the *Railway Safety Act* covers all federally regulated railways. In general, a federal railway is one that crosses international (i.e. USA) or provincial boundaries. In Ontario, federal railways include not only the long established railways like the Canadian National Railway (CN Rail), the Canadian Pacific Railway (CP Rail), and VIA Rail the passenger carrier, but also newer ones like RaiLink, the third largest freight carrier now in Canada which operates over 350 miles of track in Ontario, and the Ottawa Central Railway which is an 83 mile freight connector in the City of Ottawa.

Also the Province of Ontario has officially delegated to us its safety jurisdiction over provincial railways. Provincial railways are generally defined as railways which operate solely within one province's boundaries. Under the *Ontario Shortline Railways Act* of 1995, Ontario provincial railways are subject to the same safety requirements and regulatory scrutiny as those in the federal domain. These provincial railways are a diverse lot including small museum train operators with diesel or steam locomotives running excursions for 4-15 miles, and freight haulers ranging from the 25 mile Ontario L'Orignal Railway which runs one train daily to the Huron Central Railway which runs eight trains daily over 215 miles of track. As a matter of interest, private industrial railways like those of Inco and Algoma Steel, and recreational railways such as the one operated by the Toronto zoo are self-regulatory.

The second Act we administer is the *Transportation of Dangerous Goods Act*. Its scope is much broader than that of the *Railway Safety Act*. It applies to all railways whether federal, provincial or private and, indeed, to all modes of transport as well as to shippers and others who offer or handle dangerous goods. Many other regulators are involved in its administration in addition to ourselves - the Province for highway carriers, Resources Canada for the transportation of explosives, and the Atomic Energy Control Board for the transportation of radioactive materials, to name but a few. Proper transportation of dangerous goods encompasses appropriate classification of dangerous goods into one of nine classes and corresponding subdivisions, placing the dangerous goods in an approved means of containment with relevant safety marks, making sure the dangerous goods are being transported with the proper shipping document, and having appropriate measures in place to respond to accidental releases.

Administration of Part 11 of the Canada Labour Code for occupational health and safety of train crews is our third mandate. The Canada Labour Code ensures three basic rights of employees: namely the right to know about hazards in the workplace and how to deal with them; the right to participate in the mitigation of those hazards; and the right to refuse dangerous work.

So how do we in Ontario Transport Canada help the 25 railways now under our purview meet their obligations under these three Acts? Our overall strategy comprises a balancing of activities amongst enhancing the railways' and other stakeholders' knowledge of the safety requirements, conducting a comprehensive program of regulatory surveillance, and taking action in the event of non-compliance. From my perspective, the keys to our success are effective safety intervention commensurate with risks, partnerships, a skilled internal workforce, and public confidence in the safety and security of the rail system. Our objective is to ensure enduring safe railway practices.

Increasing railway awareness of regulatory requirements is our first very important activity in Ontario. This is all the more important because we do not approve a railway's safety compliance through licensing or certification. Through education and promotion our 30 or so technical officers provide advice and education on the specific details of our regulatory requirements, our compliance programs, and particular safety issues. There are many forums. For example, we hold formal high level meetings with senior railway officials to exchange information, discuss safety issues and solutions, and, more generally, to further positive working relationships. I will mention here as well Ontario's contribution to a major national initiative, known as "Direction 2006", to reduce by 50% grade crossing and trespassing accidents. Crossings and trespassing continue to represent perhaps the most complex and problematic areas for public safety because solutions involve educating many players and working with many safety variables. For information on dangerous goods, we have a "hot line" set up in our office to provide timely telephone advice and we participate in many shipper association meetings. Similarly, for the *Canada Labour Code* we attend many railway committee meetings to explain responsibilities relating to the committees themselves and procedures for refusals to work. These activities are complemented by the day-to-day assistance we provide through our field work and through responses to inquiries - activities which have become even more important (and, I might add, more challenging) with the many new entrants to the industry, new railway technologies, and new operating practices.

In conjunction with providing advice and education, we monitor and enforce safety. From our field offices we review railway performance to ensure adherence to regulatory requirements and maintenance of adequate safety levels, and we intervene when we find that safety is being compromised. We carry out random checks and more concentrated inspections, based on information and findings from the Transportation Safety Board, railway incident and accident reports, union or public complaints, and on our own experience. In the majority of cases, we work in partnership with the railways to identify and resolve problem areas. Rarely do we have to resort to more forceful enforcement action like formal warnings, cease and desist orders, or prosecution. Without the potential use of these sanctions, however, we would probably not be as effective or as quick in receiving voluntary corrective action from the railways.

Lastly, we assist at accident sites, whether we are there to limit the ill effects of an accidental release of dangerous goods, to assist in emergency response, to investigate a serious mishap to a crew member, or more generally, to provide guidance at high profile and serious occurrences. We ensure timely response through a 24 hour standby number. Anytime there is an accident, all of us at Transport Canada are concerned. We find out what happened, principally through investigations conducted by the Transportation Safety Board and by the railways themselves. We then work closely with the railways to make sure any necessary changes are made.

I mentioned earlier that we in Transport Canada play a kind of safety watch-dog role. I will now spend a few minutes highlighting some of the more prevalent safety issues we are seeing in Ontario.

First, railway operations. The top recurring infractions to the Canadian Railway Operating Rules (CROR) to date are: CROR 112 (securing equipment); 104.5 (restoring and locking of derails); 83 (issuing and posting of operating bulletins); and 103 (c) (blocking of public crossings). More generally, we are keeping our eye on safety issues concerning hours of service, remote control locomotives, main track movements without end of train two-way telemetry devices, reduction in the number and changes to the type of crew members, protection of foremen on or about track, radio communication between rail traffic controllers and crews, and training and supervision of crews, including American crews coming into Canada.

With respect to rolling stock, the most common safety defects relate to wheels, brake rigging, draft systems, car bodies including door securement and, for freight, open-top loading, and roller bearings. We are also involved with issues concerning passenger train emergency procedures, compliance to the new Locomotive Safety Rules, mechanical fitness of american freight trains entering Ontario, and new equipment technologies found on the Flexliner, Iron Highway, Road Railer and ECO Rail trains, as well as older technologies being used by some of the provincial museum train operators.

And in terms of dangerous goods, we have been seeing recurring safety issues related to stub sills, overweights in certain tank cars, dangerous goods documentation, employee training, and emergency response.

When we look at the railway infrastructure, there are a number of areas of concern. Not surprisingly, perhaps, they relate to deterioration of crossing surfaces, obstruction of sight lines at crossings for vehicles, inadequate drainage of ditches and culverts, poor condition of ties, and defects in turnouts.

A common thread arising from all of these safety issues is the question of the adequacy of the railways' own management systems to properly assess and effectively control risks to the health and safety of staff and the general public. This theme is fundamental to the recent amendments to the *Railway Safety Act* and is my third topic of discussion.

The *Railway Safety Act* defines a Safety Management System to be:

> *"a formal framework for integrating safety into day-to-day railway operations that includes safety goals and performance targets, risk assessments, responsibilities and authorities, rules and procedures, and monitoring and evaluation processes".*

The purpose behind regulating the adoption of a Safety Management System by each railway is to ensure that safety risks are identified and then receive attention and resources through contingency plans to mitigate their probability and consequences. In addition, a Safety Management System will enable each railway to demonstrate, in a concrete and visible manner, its commitment to the safety of employees and the public.

The intent is to borrow from the successes of many other organizations who have used the safety management system concept as a tool to better realize their objectives. A number of the railways in Canada are well ahead in incorporating safety management systems like CN Rails's 14 point plan and CP Rail's Safety Action Plan. These experiences will be central to the dialogue and consultation on the development of a Safety Management System Regulation. This Regulation will complement existing regulatory requirements rather than replace them.

Once in place, field offices will be responsible for ensuring compliance to the Safety Management System Regulation. Inspectors will seek the answers to three distinct questions: Is there a system in place and does it meet the requirements? Is the system being followed in practice? And finally, is the system effective in ensuring the safety of railway operations? The focus will be first on evaluating whether railways have implemented risk control strategies that eliminate unacceptable risks or mitigate to an acceptable level those risks that cannot be eliminated entirely, and secondly whether they have adequate systems to react and to learn from failures, incidents, and accidents. In order to make these evaluations, inspectors will be trained in auditing type techniques for it is expected that they will be engaged in cyclical audits of railway safety management systems.

I would like to conclude with a number of observations from my perspective as Regional Director for Ontario. First, Canada's railway system is among the safest in the world and current safety trends are encouraging. However, there is room for improvement. I believe that safety performance will continue to be closely scrutinized, particularly as more companies come on the scene. Recent experience has shown that some newer railways can have less safety knowledge and experience, and fewer safety systems in place; smaller railways can have Class 1 derailments, collisions and dangerous goods spills. We in Transport Canada have to accommodate the special needs of smaller railways through increased attention and education. On the other side of the coin, we need to provide the consistent top safety performers with greater freedom and flexibility.

Secondly, we all need to continue our efforts to reduce crossing and trespassing accidents, the major causes of fatalities and injuries. Public interface with rail operations is an area where the railways have less than total control but where the dangers are of great consequence. Because crossing improvements, fencing, and alternative access routes are big ticket expenditures, there remain disagreements amongst the many players about who should pay. To help out, we need a clearer delineation of the multi-jurisdictional safety responsibilities in these critical areas, a clarification that we should see shortly with the changes to the *Railway Safety Act* and the enactment of new Crossing and Trespassing Regulations. This in turn, should provide useful guidance to the Canadian Transportation Agency when it deals with disputes on cost allocations.

There are other public interface issues that need our attention as well. These days, the public is much more vocal about the number and speed of trains, dangerous goods trains, noise from whistling or shunting, locomotive emissions, and crossing blockages. Since public support and confidence remain important ingredients for our success, we need to recognize and respond effectively to issues relevant to the community. In some cases this translates into a more hands-on, direct safety role for us; at other times the resolution of public concerns puts us into a mediating type of role to encourage compromise amongst differing viewpoints.

I reflect as well that the railways need to become even more self-reliant, and indeed, proactive, in correcting enduring safety problems. There are still instances today when the railways hesitate to take action or only do so after Transport Canada's push or intervention. On the other hand, we in Transport Canada sometimes concentrate too much on minor safety problems rather than on high risk areas. I am optimistic that the adoption of formal Safety Management Systems will help us both. It will allow the railways to demonstrate their full responsibility and accountability for safe railway operations. And in turn, it will allow Transport Canada to move to a more risk based and audit approach to monitoring safety.

With respect to industry-regulator relationships, I am pleased with the progress that has been made over the past number of years as a result of the collective will of many people.

Today we typically work in an inclusive, collaborative and results-oriented way to address safety issues. This is in contrast to the old style of command and control. Unfortunately, there are still occasions when we face off in a confrontational manner or when our mutual communication does not keep abreast with the quick-paced changes in our environments. We need to keep working on building constructive relationships, which in turn bring mutual respect and trust. For, I am convinced that at the end of the day, it will be our positive working relationships and open communication that will carry us forward to find solutions to long-standing problems and new challenges.

To continue these effective relationships, we as a regulatory body will have to remain relevant and progressive in this very dynamic environment. It has, indeed, been a sizable task to keep the inspectors abreast of these fast paced changes and to provide an environment conducive to training and development. However this effort is crucial because it is our inspectors that provide the value added to our programs. It is also crucial because inspector credibility with the industry goes along way in encouraging voluntary compliance.

In addition, the fast paced changes have placed greater emphasis on our need to be responsive, proactive, and adaptable. Although we strive for one safety regime for all, our field activities have to be tailored to meet specific railway needs within the context of consistent national programs. For example, we find that some railways respond better to education or incentives, whilst others need firmer intervention. The challenge, however, as we customize our delivery is to maintain fairness, consistency, impartiality, and predictability.

Relationships need to evolve as well with our colleagues in other agencies of Government. For example, our tri-partite working arrangement with the Canadian Transportation Agency and the Transportation Safety Board needs re-adjustment to reflect the changing roles and styles in all three of our organizations. Internationally we need to continue our connections with our american counterparts in the Federal Railway Administration (FRA) to learn from each other and to harmonize safety requirements as much as possible. In the Ontario Region we are enthusiastic about our joint cooperative ventures with the FRA and, closer to home, with the aviation and marine organizations in Transport Canada.

There are many other challenges on the horizon as well. I am confident that together with the railways and stakeholders, we in Transport Canada will address them, learn from them, and succeed.

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Terry Atkinson

Railway Safety Regulation in relation to Tolerable Risk and Best Practice Benchmarking

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RAILWAY SAFETY REGULATION IN RELATION TO TOLERABLE RISK AND BEST PRACTICE BENCHMARKING

Paper by Terry Atkinson, Manager Rail Safety, Land Transport Safety Authority of New Zealand

To be presented at the 1999 International Railway Safety Conference, Banff, Alberta, Canada

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1. INTRODUCTION

Government regulation of railway safety around the world takes many different forms and Government intervention ranges from total "command and control" involvement to a "stand back" approach.

The former approach includes the prescription of standards, compliance inspections, spot checks, imposition of sanctions and policing of remedial action and allows the Government regulator a share of the accountabilities for safety. It is recognised this is the approach adopted in the USA and Canada.

The latter approach leaves the organisation that creates the risk carrying the responsibility, based on self-management within the defined parameters of reasonable railway operating practice. The regulator is expected to monitor safety performance in order to be able to give the necessary safety assurances to the Government and people it represents.

The New Zealand "stand back" approach has a regulatory involvement commensurate with the size of the problem it is attempting to mitigate. It is recognised that no two railway operators or owners are alike and that the safety record and accident potential of each will determine what level of regulatory intervention is appropriate under specific circumstances.

Using risk tolerability, "willingness to pay" and "willingness to accept" value of statistical life criteria, the cost and benefits of risk mitigation can be assessed as being reasonable or otherwise.

The performance of railway operators and effectiveness of the regulatory regime needs to be addressed against set key performance criteria. This may take the form of an assessment of actual measured levels of risk against pre-defined generally tolerable or acceptable levels or comparison with some form of "best practice" benchmark

The Land Transport Safety Authority of New Zealand (LTSA) has undertaken a project to determine "best practice" in railway safety around the world.

From initial contacts it has realised that currently many rail safety regulators have few measures of their own success other than improving or worsening trends in specific elements of the safety parameters measured. A regulator such as the USA Federal Railroad Administration (FRA), which has a number of "clients", has the opportunity of making comparisons between individual railways and States and will be satisfied through controlled interventions in the worst performing areas that it is being effective.

The LTSA's research has shown that in many such administrations around the world, the collection of meaningful accident and incident data for the railway industry is not commonplace. Where data is collected, it tends to be employed internally with little (if any) comparison outside each regulator's own border. Recognised difficulties 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.

Because we have only one major railway in New Zealand there is a real need for us to have some basic performance measures available from worldwide sources to allow definition of tolerable safety performance of our railway and effectiveness of safety regulation. The principle purpose of our interest in international benchmarking is to allow us to gauge the safety of our industry relative to "best practice" standards so far as valid and reliable comparisons can be made, to provide a measurable basis of continuous improvement.

From our close relationships with Australia we recognise there also as a need for the Australian industry to recognise some such reliable benchmarks and we believe that many regulatory authorities and railway administrations around the world would welcome such comparisons.

The LTSA has decided that the best commencing point is a high level comparison of accidents taking account of fatalities to produce a fatal accident rate and serious injuries/ minor injuries (where recorded) to produce an "equivalent fatal accident rate".

This can be compared across various operational activities of a number of railway entities.

Subsequently, secondary level measures such as numbers of collisions, derailments, level crossing accidents, loading irregularities and signals passed at danger (SPADS) are analysed.

As may be expected, some real problems in comparing "apples with apples" have been uncovered by the New Zealand exercise and the need for a common set of definitions for data collection and measurement normalisers is essential.

This 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, it is understood that proposals to form a "benchmarking club" were first made to an earlier meeting of this Conference some seven years ago.

New Zealand has established good relationships with a number of railways and regulators around the world to enhance the information-sharing circle. It is hoped that its project could be further enhanced in future years through the auspices of this Conference, which may encourage the evolution of an effective "benchmarking club"

The approach adopted can be challenged by learned risk management statisticians and academics, who would see it as being insufficiently complex. This provides a simple, easily applied approach, which has long-standing acceptance through government safety agencies in the United Kingdom and provides a meaningful, common sense way of making comparisons.

2. LTSA RISK MANAGEMENT PHILOSOPHY

The fostering of a safety culture in any railway operation must be a central core of successful business management and the understanding and management of the risks should be fundamental. By being constantly aware and making the necessary changes leading to the implementation of incremental safety improvements, the likelihood of a single catastrophic event is almost certainly reduced.

The railway industry is inherently hazardous and it is necessary through good management to ensure that frequent, unsafe occurrences have only minor consequences and the likelihood of a catastrophic event thereby reduced This is the case in most countries where the public has high expectations of the right to remain safe and modern safety management principles are applied.

Comparison with "best practice" industry benchmarks is a means by which a measure of success can be obtained

Absolute safety is unattainable and regulatory intervention cannot be seen to favour unreasonable investment to lower the risks of railway operations to such levels that they are not economically viable.

In New Zealand, the Government requires safety to be regulated within the bounds of "reasonable cost", which requires that the cost of safety activities be less than the benefits of reducing the associated risks. The LTSA has developed an approach to risk management in railways built around a philosophy based on the principle of "ALARP" - As Low as Reasonably Practicable.

This principle requires that all industrial risks be reduced to levels that are within the ALARP region - the area between the upper and lower limits illustrated on Figure 1 below. The risks falling within the ALARP boundaries (Tolerability Region) may then be the subject of cost/benefit calculations to determine a value of undertaking risk mitigation steps.

Fatalities and serious injuries are costed using value of statistical life criteria (currently $2.5 million per life in New Zealand) based on "willingness to pay" and "willingness to accept" research.

This principle is the basis of all Health and Safety legislation in the United Kingdom and is used by HM Railway Inspectorate in considering the railway industry in the UK.

The LTSA has adopted a two-tier approach to safety analysis - high and secondary - with the high level being comparisons of fatalities and serious injuries using the "individual risk criteria" approach to determine key performance indicators. This approach asks the question

"What is the risk of me as an individual being killed or injured by a certain activity in any year?"

A 1in 1000 risk would, for example, suggest that in an exposed group of 1000 people undertaking a certain activity, on average, one person would be killed by that activity every year

The secondary level records unsafe occurrences and normalises the data in a number of ways.

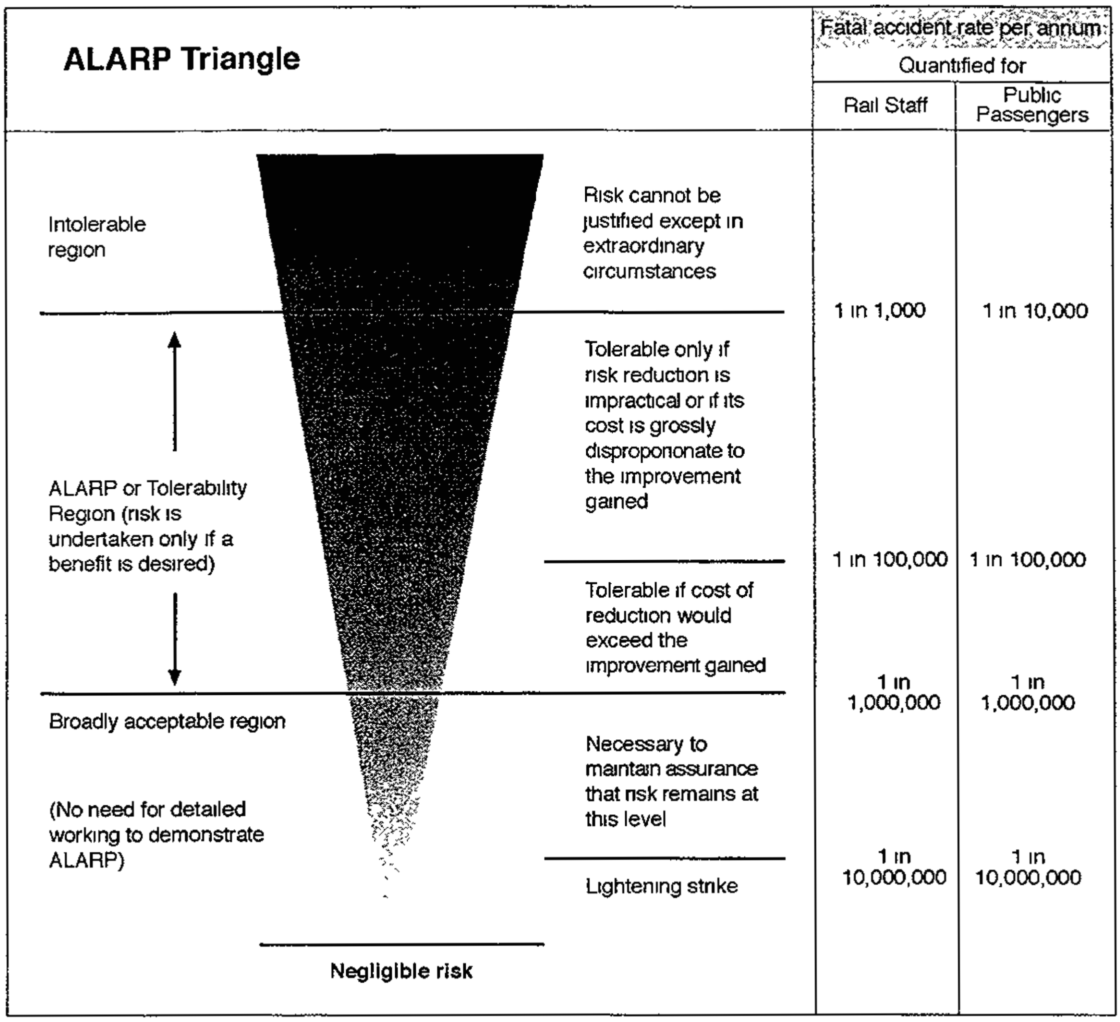

Figure 1

Such occurrences are derailments, train collisions, level crossing accidents etc , which are "operating occurrences" that may or may not have involved injuries to people, but indicate levels of unsafe activity from which the success of mitigating action can be measured by trends over time.

Similarly this type of analysis can be extended to lower level data such as infrastructure/mechanical failure (broken rails, track buckles, hot boxes, defective brakes etc.), where significant to the problems of individual railways and providing they are reliably recorded.

If, however, such failures are found and remedied during the normal course of maintenance and do not cause a more serious incident they are unlikely to be conscientiously reported. It is recognised this will vary between administrations and the significance of such data will depend on the ability of individual railways to recognise and record such occurrences. In New Zealand, however, because of the dubious nature of this data, the LTSA considers the value for safety regulation to be minimal and it is therefore discounted in the LTSA's current considerations.

For data comparison using the "individual risk" approach numerical values are placed on the "intolerable" and "acceptable" levels of risk from the view-point of both the individual persons and society as a whole. Between these levels (the ALARP area) the business must make every effort to reduce risk in so far as is reasonable, taking economic considerations into account.

It is common practice when calculating risk levels to include the risk of injuries as well as the risk of death. Risks are then expressed in terms of "equivalent fatalities" which are calculated as follows:

Equivalent Fatal Accidents = (Fatalities + Serious Injuries/10 + Minor Injuries/200)

Other than for staff injuries, some of which are reported to Health and Safety authorities, the reporting of minor injuries by passengers or members of the public is not common and data held (if any) would be of dubious value. Only fatalities and serious (lost time) injuries have therefore been considered for this study.

In its capacity as the New Zealand Government regulator of railway safety the LTSA has responsibility for administering the requirements of railway safety legislation. Under the legislation, rail service operators are required to notify accidents, incidents and some lesser safety related events that occur in the rail service under their management.

As well as fatalities and lost time injuries, trends in a number of other parameters relating to railway safety can be determined from the key occurrence data provided by the operators. This information, appropriately normalised, is used as a secondary level of data, which providing "apples with apples" comparisons are made, can be used to determine a picture of the safety health of a railway in specific key areas in comparison with acceptable levels of incidence in other railways.

The regulator's overall concerns must be to safeguard against unsafe operating practices by the monitoring of conditions and situations where deteriorating trends increase the operational risks to approach unacceptable levels, taking "reasonable cost" criteria into account. The objective must be to strive for continuous improvement in railway safety, at the same time recognising unreasonable cost implications.

This paper primarily relates to the use of historic data to establish a position in the assessment of the safety of individual railways relative to benchmarks, in comparison with other railways and against tolerance limits, *(analogy - picking up the pieces at the bottom of the cliff)*. The same method of assessment should be used to assess the risks of new and amended processes, presenting different hazards *(providing a fence at the top of the cliff)*, to ensure changes in the risk profile continue to be tolerable.

3. SCOPE OF THE LTSA STUDY

Early in 1999 the LTSA initiated a study into a sample of international railway safety statistics so that comparisons could be made to available New Zealand information. The type of information gathered and the relative performance measured by the statistics has been analysed, allowing certain conclusions to be reached about current New Zealand performance.

A search of Internet sites was first initiated as it was thought that railway safety statistics might be well represented on this medium. However, it was disappointing to find, after a comprehensive search, that only USA, Canada and Great Britain appear to be represented this way, in any detail.

The information from the USA is that provided by the Federal Railroad Administration (FRA) on their web-site. It is very comprehensive and it was found to cover at least the last 4 years.

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 it was found to cover at least the last ten years.

The information from Great Britain is that provided by HM Chief Inspector of Railways of the Health & Safety Executive on their web-site and a summary report bulletin for the 1997/98 year was found.

The Government regulators of many other countries have web sites but not for the publication of railway safety information.

Information was also sourced through the work of the Railway Safety Committee of Australia by which the LTSA maintains direct contact with the Government regulatory authorities of all States of Australia as well as some staff of railway operators.

In an endeavour to get a wider set of information, approaches were made by fax to selected Government agencies in Denmark, France, Germany, Ireland, Japan, Netherlands South Africa and Sweden.

The New Zealand Railway operator information predominantly relates to that provided by Tranz Rail Limited, as the major network operator. Whilst the LTSA receives safety occurrence information from all of the other 70 New Zealand railway operators (heritage railways, tramways and industrial lines), the number of unsafe occurrences are so minimal and generally of a one-off nature that they have not been included in any comparison statistics. The study used Tranz Rail data alone for comparison purposes with the overseas information received.

4. LIMITS FOR FATALITIES AND INJURIES

4.1 Individual Risk Criteria Approach

The main objective of any safety system is to minimise the risk of harm to persons. Fatalities and injuries to people are the outcome of failures in the safety system and to that extent represent the tip of the iceberg in relation to a measure of the unsafe activities that may be actually occurring However, if measured historically over reasonably long time frames they better represent the relative safety risk to individuals exposed to particular activities.

The individual risk criteria "1inX" approach provides an easy to understand and easy to calculate method of determining risk and is useful for monitoring performance indicators, and determining risk tolerability levels. It can also provide simple comparisons relative to the safety of other transport modes such as road, air, maritime etc.

Resulting from recent work done by a UK Risk Management Consultant in Ireland and made available to the LTSA, intolerable and tolerable levels of risk for application of the "As Low As Reasonably Practicable" (ALARP) principle have been determined by reference to a European Standard (prEN 50126:1995). This recommends the FAR upper tolerability limit for new railways be set at 1 fatality per 100,000 exposed persons per annum. The consultant's experience in working with a wide range of rail operators suggested that because of the considerably higher frequency of occurrence, the EFAR upper limit be set 2.5 times higher than the FAR - ie at 1 equivalent fatality per 40,000 exposures.

Because Tranz Rail represents a mature, existing system, we have accepted less onerous values (one order of magnitude) for the tolerability limits. Doing so avoids a commitment to levels of financial investment to achieve the same levels of risk tolerability that could be expected from a completely new railway asset This approach supports the "safety at reasonable cost" requirements for safety regulation which is in line with the New Zealand Government policy for transport safety. The UK Health and Safety Executive has set the precedent for this approach by suggesting that it could readily expect an order of magnitude lower intolerable risk criterion to apply to a new facility than for one existing.

The accepted upper limits of tolerability for this purpose are therefore 1 fatality per 10,000 per annum (FAR) and 1 equivalent fatality per 4,000 per annum (EFAR) for passengers and the public.

Again, in line with UK Health & Safety Executive advice and common international practice, the criteria for staff risks are set at 1 fatality per 1000 per year and 1 equivalent fatality per 400. These or similar figures have been already adopted by several world Railway Authorities for risk management purposes.

In consideration of the ALARP principle it is usual to set the broadly acceptable limits approximately two orders of magnitude below the intolerable levels with the criteria being set at 1 fatality per 1,000,000 and 1 equivalent fatality per 400,000.

The lower "broadly acceptable" limits for staff are suggested to be the same as for passengers and the public.

The table below summarises the individual risk criteria adopted. Refer also to Figure 1.

EXPOSED GROUP	Fatalities per annum		Equivalent fatalities per annum	
	Upper Limit	Lower Level	Upper Limit	Lower level
Passengers	1 in 10,000	1 in 1,000,000	1 in 4,000	1 in 400,000
Staff	1 in 1,000	1 in 1,000,000	1 in 400	1 in 400,000
Public	1 in 10,000	1 in 1,000,000	1 in 4,000	1 in 400,000

4.2 Staff Lost-Time Injuries

The lost-time injury (LTI) rate is a measure used in recording staff injuries. The USA uses a rate (hours lost) per 200,000 hours worked and this has also been adopted as a measure in New Zealand.

The LTI Rate = No of LT Injuries x 200,000/Actual Hours Worked.

As each staff member works approximately 2,000 hours per annum the resulting figures approximate to a percentage of the work force that is injured per annum. Tranz Rail has reported its performance in the order of 6 LTI per 200,000 hours (6%).

The figures supplied by the FRA equate to the USA average being around 3 to 3.5 per 200,000 hours (3-3.5%) and Tranz Rail have set this rate a key improvement objective.

The best performance in USA railways in recent times has been Norfolk Southern, which has turned in figures below 1 LTI per 200,000 hours. A good world class benchmark target appears therefore to be to get lost-time injuries down to less than 1% of the workforce per annum.

5. SECONDARY LEVEL DATA

Although many agencies around the world record such data, (derailments, collisions, level crossing collisions etc) the definitions of the information collected becomes increasingly critical and accuracy of reporting/data collection dubious. It therefore becomes difficult to make meaningful comparisons. The LTSA believes useful data comparisons could be available at this level in the future, providing work is done on standardisation of definitions and normalisers.

The detailed data available from USA, Canada and Great Britain includes secondary level performance indicator information such as running train derailments, train collisions, level crossing collisions, etc.

Some data was also available from Australia, Sweden and South Africa, but in attempting to make comparisons it is evident there are problems in getting consistency of definitions and normalising factors.

For example, Tranz Rail reports the derailment of all "running trains" (a train which has been signalled to depart and which has not yet berthed on arrival). There is no requirement to take account of the cost of damage. If there is no associated personal injury, FRA reporting takes account of a monetary value of damage before a derailment is required to be reported (currently >US$6,600 - sayNZ$15,000).

In New Zealand, derailment of running freight trains is very common (average of 67 per year over a 3 year period 1996-98 for a small number of relatively short journey and low speed trains). There may have been an element of "good luck" because despite the frequency, they have generally been of low consequence on the safety of people. Over many years very few have resulted in fatalities or serious injuries. A significant proportion of those currently included would not be counted if a damage value as used in the USA were considered. Compared on this basis a significant improvement to the Tranz Rail derailment statistics would be recorded.

6. LOW LEVEL OCCURRENCE STATISTICS

Low level occurrence data such as that associated with infrastructure/mechanical failures (defective rails, track buckles, defective rolling stock etc.) is not usually reported to the LTSA if found by testing or during the normal course of maintenance and has not caused a more serious incident. Records are kept of such defects as reported but these are generally insignificant in relation to the ability to infer significant adverse trending.

Given the need to ensure that the high level and secondary level occurrences are reported on a consistent basis by agencies sharing benchmarks, which will require a coordination process of some difficulty, it is not considered worthwhile to pursue comparison of low level data for the current study.

Whilst it is accepted that low level occurrences are a measure of underlying safety issues, high level data incorporating the actual fatalities and injuries and the consideration of secondary tier data appear to be a basis for more meaningful overall comparisons at this stage.

7. REQUIREMENTS FOR BENCHMARKING

7.1 International Comparisons

From the research done for this project, it appears that although 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.

For example, the FRA collects and publishes data regarding many individual railways and is able to produce league tables on the situation across the USA. The UK Railway Inspectorate analyses incidents and dangerous occurrences between different railway companies and by different regional zones.

It is evident that direct comparisons between different types of railway (eg. high speed freight v. light rapid transit) would give misleading results if the limitations on the comparisons are not consciously recognised and the definitions of apparently similar indicators used by different agencies could likewise mislead.

However, for these and other similar reasons the widespread ability to make meaningful comparisons has, in the past, been frustrated. Many good intentions have ended in failure.

At the 1998 International Railway Safety Conference in Sydney, Australia, senior representatives of the railways, unions and Governments of eleven countries were present with an obvious common interest.

The presence of international delegates each year at this conference provides an ideal opportunity to gain common advantage by breaking down the barriers of the use of dissimilar indicators, getting agreement on a series of common indicators or at least beginning to recognise the significance of the differences. This is seen as the nucleus of forming an international "benchmarking club" and to provide a common focus for an important aspect of the annual agenda of the conference.

For international benchmarking purposes there is a need to recognise common definitions of safety occurrence data and a common set of normalisers. These need not be at the expense of individual agencies' normally accepted data presentation but in addition to it.

A central repository of this data would analyse and present the statistics to participating agencies at (say) six-monthly intervals. It would be up to each individual agency to interpret the data in the most appropriate way for its own requirements.

7.2 Definitions of Occurrences for Comparison Purposes

7.2.1 General

In Australasia, coordination of railway safety is carried out through the Railway Safety Committee of Australia chaired by the Federal Government, on which all of the Australian State regulators, a number of railways and the LTSA of New Zealand are represented.

Through application of AS4292 (the Australian Railway Safety Management Standard), which suggests a uniform basis for recording statistics in the main categories of accident and incident reporting, agreement on these has been agreed in principle, although the categories and definitions of the information to be recorded have not been finalised.

In addition to comparison with Australia, the LTSA has a desire to be able to make comparison with International "Best Practice" safety indicators and, if possible, establish a benchmarking club for worldwide exchange of safety data

Outside of Australasia there appears to be little agreement on the format of statistics presented. To allow comparison internationally there is a need to understand the definitions of data collected by the various participating agencies world-wide and for the central repository of the data to review the relevance of the data available and call for it to be reordered as appropriate and necessary.

7.2.2. For Analysis of Individual Risk Criteria

The following are offered as suggestions for the collection of information to calculate the individual risk indicators for passengers, public and staff:

A fatality includes injury-related death within 30 days of the occurrence and serious injury recorded as requiring admission to hospital.

Number of fatalities and serious injuries occurring to:

- **Passengers.** A person on a train, whilst boarding or alighting and including passengers walking or standing on platforms and walkways, within the confines of the station platform area. Does not include death, injury from illness or drug/alcohol related effects whilst a passenger.

- **Staff.** Record by broad occupational groups.

- **Public at level crossings** Separate recording of pedestrian and vehicle occurrences.

- **Trespassers.** Persons killed or injured whilst illegally on railroad property including apparent suicides

- **Other public.** All others excluding trespassers and suicides.

An overall industry indicator is of course represented by the total of the above categories.

These may be for individual years or totalled and/or averaged over a number of years for which data is available. A meaningful measure for an individual organisation can be a comparison of the latest statistics against the average over a number of years.

"One-off" major events can appear to skew the statistics over time but these must be recognised and appropriate allowances made to include/exclude such data in order to be able to understand the data and to ensure desired comparisons are not invalidated. As such data becomes older, its relevance to present circumstances becomes increasingly less.

- **Lost Time Injuries.** Number of working hours or shifts lost before return to work for all categories of on the job injury to staff.

7.2.3. For Collection of Secondary Occurrence Data

Count the number of occurrences. Normalise as below.

Collisions: In this category comparisons are made for running train related collisions including collisions between running trains and any other train, load on a train or open door etc. At a lower level statistics for all collisions occurring in yards excluding those occurring during the normal course of shunting may be collected.

Running Train Derailments: Derailment of a train which has been signalled to depart and which has not yet berthed on arrival, causing death or serious injury or damage exceeding (say) US$10,000 (not taking account of recovery costs). Separate passenger, freight and "other" operations.

Level Crossing Collisions: Collision between a train and a road vehicle. Collision with a person at a road or pedestrian only level crossing.

Signals passed at danger (SPADS): All instances of over-running of a signal at danger except for minor misjudgments.

Loading irregularities: Significant load shift and load falls from wagon

7.2.4. Normalisers

It is the intelligent use of normalisers that can most readily allow comparison of key indicators across different international agencies.

The overall quantum of safety statistics may be presented in several different ways in order to reduce the "gaps" between various types of railway operation and to allow consideration of different perspectives for comparisons By presenting a range of normalisers, and using those most relevant to the comparison required, the results can be more easily rationalised for specific circumstances.

This would allow confirmation of the domestic performance through a specific set of indicators against others, in ways that can be rationally explained by an organisation without disclosure of absolute differences. Similarly the bland analysis leading to "overall" performance may hide problems in those groups subjected to higher exposure. Considering the population of those groups alone in order to highlight problems in specific areas may separate these groups out.

In the absence of definitive data for normalisers, providing reasonable assumptions are made and appropriately noted, assessments of the normalising factors could be acceptable This may be preferable to an outright dismissal of the usefulness of the statistic because totally accurate records of the factors are not available.

Use of specific analyses may provide for companies with commercial sensitivities to protect, by allowing the sharing of information amongst the benchmarking club members to be presented in the form of several league tables without any associated commentary.

The following are suggestions of some suitable normalisers but they do not represent a comprehensive list of possibilities. Such a list may be developed over time to satisfy the specific needs of individual members of the benchmarking club.

For high level fatalities and injuries

Overall Fatal Accident and Equivalent Fatal Accident Rates

Totals or passenger/freight split as appropriate

- General population of country/State or defined exposed portion of population. *(millions)*

Of Passengers

- Total passenger journeys per annum
- Total passengers exposed to specific journeys routes or services
- Total train kilometres (miles)-(passenger/freight)
- Passenger numbers x kilometres (miles)

Of Public at Level Crossings

Separate pedestrians and vehicles

- General Population
- Numbers of level crossings
- Population of road vehicles exposed to level crossings (estimate). (Note: in some areas level crossings may not exist)
- Train kilometres (miles)

Of Railroad Staff

- Total staff numbers
- Staff sub-groups exposed to specific risks (eg track staff, shunters, train crews etc.)

  or simple proportion of sedentary to active workers

- Staff hours worked (to calculate LTI's)

Of Trespassers and Suicides

- General Population

Of Other Public

- General Population

For secondary occurrences

Collisions

- Total train kilometres (miles)

Running Train Derailments

- Train kilometres (miles): Passenger, Freight and Total
- Tonne-kilometres (miles) for freight
- Axle-kilometres (miles) for freight (Note: allows comparison of average train size and journey distances)
- Passenger-kilometres (miles) for passenger trains

Level Crossing Collisions

- Total Train kilometres (miles)
- General Population
- Other normalisers as for fatalities and injuries above

Signals Passed at Danger (SPADS)

- Total Train kilometres (miles)
- Train kilometres (miles) - metropolitan passenger services.
- Train kilometres (miles) - long distance services

Loading irregularities

- Total freight train kilometres (miles)
- Freight axle-kilometres (miles) (Note: allows comparison of average train size and journey distances)

8 CONCLUSION

New Zealand has established contacts for information exchange with the Australian State Safety Regulators There is a common desire to collect and exchange data, which will allow comparison of safety performance. The closeness of the individual agencies involved allows benefits of effective communication through regular meetings and should make agreement on the definitions of the reporting criteria not too difficult. In addition the diversity and scale of operations can, to some degree, be recognised through familiarity with the local industry.

Internationally, the LTSA project has demonstrated that detailed safety statistical information can be obtained from the USA through published data and from Canada and Great Britain through published data and personal contact Useful contacts have also been made in South Africa, Ireland and Sweden and will be maintained, although information supplied to date has been incomplete.

The LTSA wishes to extend its circle of contacts and sees the International Rail Safety Conference as being an excellent forum for the associated problems to be discussed and perhaps a commitment from the delegates to consider their involvement in an international benchmarking club.

The commitment for members would be to supply occurrence data and a range of statistical normalisers on a six-monthly basis and in turn they would receive a number of league tables indicating the normalised data for all members.

The scale of operations and mix of traffic types internationally are recognised as having significant differences to the Australasian scene, but the individual risk criteria approach based on risks to people, at least, should be acceptable as a measure of a common outcome.

All other results would be available for the individual members to interpret their position in comparison to other available data and make their own judgements as to the relevance of the results available to their own particular situation.

Apart from the commentary on LTI's, no attempt has been made in this paper to present or compare data, which the LTSA is currently holding.

9. ACKNOWLEDGEMENTS

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Biographical Details

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Qualifications and Experience:

During a career of 38 years association with 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 and 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. He is the author of several papers on this subject presented mainly in Australia and New Zealand.

Land Transport Safety Authority

New Zealand

Railway Safety Regulation

Tolerable Risk and Best Practice Benchmarking

Paper to the International Rail Safety Conference - Banff

October 20 1999

Introduction

The International Rail Safety Seminar *1992* held in New Zealand

Quotes from Paper by David Maidment of British Rail:

"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"

"At our seminar at Latimer House last year *(1991)* we identified the need to attempt to develop common definitions and data supporting risk assessment......................"

Land transport safety Authority

Introduction

............"a better way forward would be to identify particular discrete areas of activity of major interest to a number of railways and exchange data ...."

"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 coordinating the definition of data required and analysing the results?

Introduction

In a paper to the same Seminar in 1992 Mr Tony Boland of the State Rail Authority of New South Wales concluded:

"The safety performance data system remains an invaluable asset to State Rail, representing vital leverage to ensure commitment and action to deliver levels of system and person safety consistent with *international best practice.*

Does it still do that?

What constitutes an acceptable level of safety?

Do we know what *international best practice* is?

Land transport safety Authority

Some further Questions

1) How many International Rail Safety Seminars have there been since 1991? Have we made progress? Do we need to make progress?

2) Are comparisons and benchmarking important to us?

3) Do we still agree comparisons are impossible - or only difficult?

4) Is this forum NOT ideal for the issues of information exchange to be addressed? If NOT - how should it be done?

5) What is "International Best Practice" in railway safety? Where is it practised?

6) Does the fragmentation of railways not make it all the more important key performance indicators are identified, shared and compared?

How safe is the railway industry?

Without wishing to diminish the need for safety regulation we should note that in the developed world RAILWAYS are by far the safest form of land transport.

EUROPEAN PASSENGER FATALITIES by Transport Mode 1996 per billion-passenger km. Source: European Commission. Transport in Figures. UN -ECE statistics

Powered two wheelers	56
Pedestrians	43
Pedal Cycles	38
Passenger Cars	7
Bus/Coach	1
RAIL PASSENGERS	.36
Air Passengers	.27

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What are the problems we are trying to solve?

Whilst we should strive to achieve elimination of all accidents that harm or damage people, property or the environment

ie. ZERO TOLERANCE

In reality, because the railway industry is inherently hazardous, the cost of achieving such an ideal situation is likely to be prohibitive. Unless we stop operating trains altogether!

We must therefore use a range of appropriate management tools such as incident analysis, set limits of acceptability and work on the projects offering the greatest benefit/cost ratios for hazard removal.

Focus should be on working for continuous improvement and having appropriate measures to confirm performance against acceptable benchmarks.

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The current situation

Regulation of railway safety is becoming increasingly important as traditional Government owned railways are privatised, fragmented and reorganised.

Data collection and analysis by regulators (as opposed to internal record keeping of individual railways) in a form that is meaningful to the industry internationally is not commonplace.

Consistency of definitions, inability to justify normalisers and the wide range of industry profiles and operational circumstances are often quoted as reasons for not attempting to make comparisons.

Potential loss of shareholder value is also a fear of the new private operators if they allow regulators access to their safety statistics although this does not appear to be a problem in the USA.

Where to start?

Fatalities are undeniable and can often generally represent themselves as a measure of the safety record of an industry.

Develop a Fatal Accident Rate (FAR).

Taking serious and minor injuries into account develop an Equivalent Fatal Accident Rate (EFAR)

Use Lost Time Injury Rates (LTI's)

- **Count:**

COLLISIONS

DERAILMENTS

LEVEL CROSSING ACCIDENTS

SIGNALS PASSED AT DANGER

LOST LOADS **ETC.**

Normalise these on a common basis and we begin to get a picture

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Safety at what Cost?

The New Zealand Government requires transport safety to be managed within the bounds of "reasonable cost".

The LTSA has accepted the "ALARP" (*As Low As Reasonably Practicable*) philosophy developed initially for the Nuclear Industry by the UK Health and Safety Executive.

All industry risks are to be reduced to levels within the ALARP region - the tolerability region between acceptable and intolerable risk levels.

The risks should then be subject to benefit/cost analysis to determine priority for mitigation action.

Fatalities and serious injuries are costed using statistical value of life criteria.

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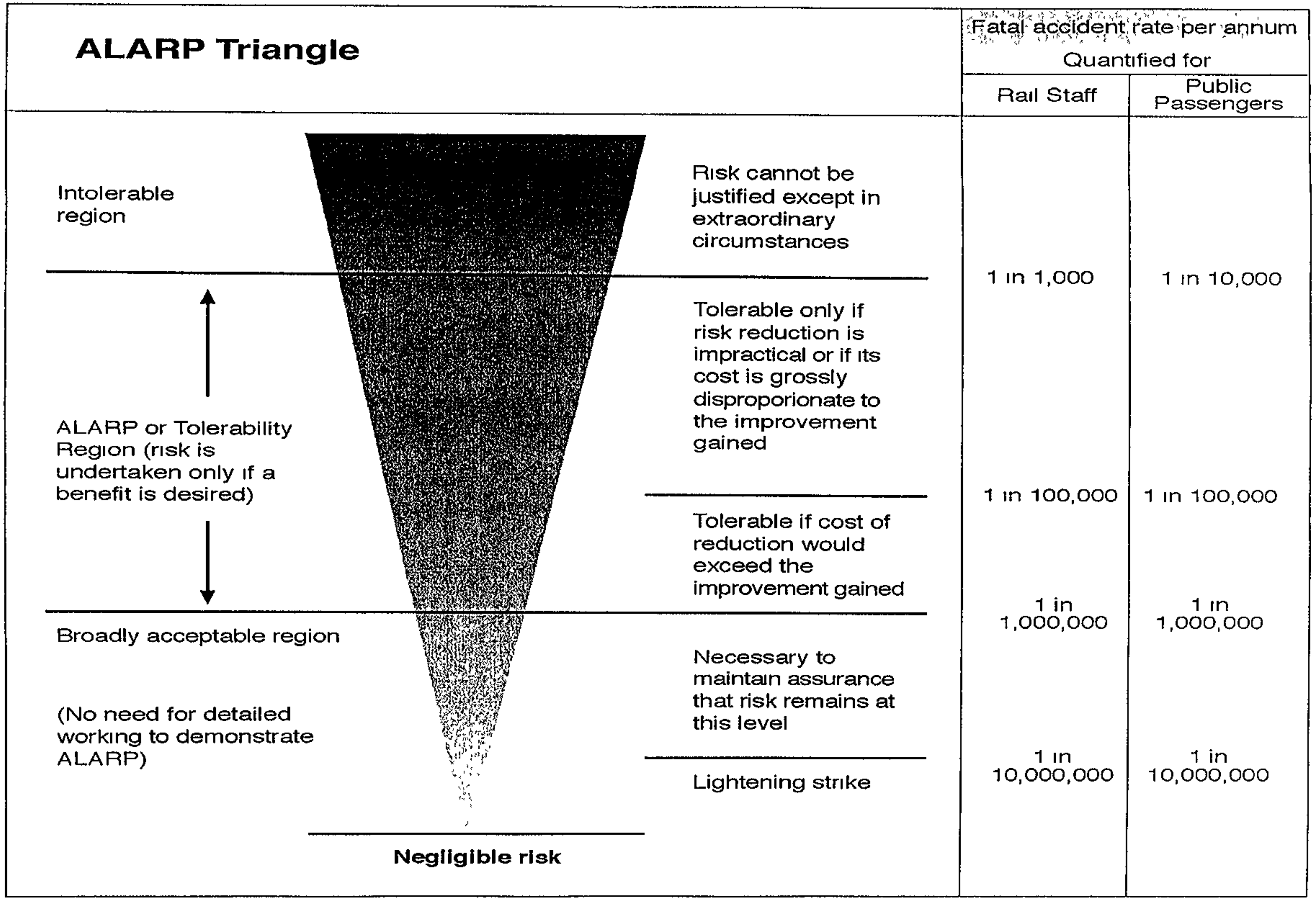
ALARP Triangle
Fatal accident rate per annum
Quantified for
Rail Staff
Public Passengers
Intolerable region
Risk cannot be justified except in extraordinary circumstances
1 in 1,000
1 in 10,000
ALARP or Tolerability Region (risk is undertaken only if a benefit is desired)
Tolerable only if risk reduction is impractical or if its cost is grossly disproporionate to the improvement gained
1 in 100,000
1 in 100,000
Tolerable if cost of reduction would exceed the improvement gained
1 in 1,000,000
1 in 1,000,000
Broadly acceptable region
(No need for detailed working to demonstrate ALARP)
Necessary to maintain assurance that risk remains at this level
1 in 10,000,000
1 in 10,000,000
Lightening strike
Negligible risk

Comparative Risks to individuals in New South Wales

Voluntary Risk Taken by those that participate	Chances of being killed by risk taken per year
Lung Cancer from smoking	1 in 1,000
Railway Maintenance	1 in 2500
All effects of alcohol	1 in 2,500
Accident in the home	1 in 10,000
Travelling by car	1 in 10,000
Swimming	1 in 20,000
Playing rugby	1 in 33,000
Travelling by train (frequent passenger).	1 in 33,000
Travelling by Air (frequent passenger)	1 in 100,000
Compare with Lightning strike.	1 in 10,000,000

Derived from table of Dept. of Planning, Sydney. 1990.

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New Zealand

Individual railways need to recognise their greatest vulnerability.

Tranz Rail as NZ's main network railway primarily carries freight but carries 12.5 million passenger journeys per annum. The type of risk is therefore identical to most other railways.

Although the quantum of the risks may be relatively low, comparison of the most common type of type of accidents is of interest.

High speed derailments; collisions and similar operating accidents are fortunately RARE.

Predominantly accidents causing death or serious injury are at Level Crossings - representing around 50% of all railway related accidents but only 0.3% of NZ's road traffic casualties.

New Zealand

The vast majority of road vehicle related level crossing accidents are caused by the unsafe actions of motorists and could effectively be called "Road Accidents".

Trespasser deaths and serious injuries (including suicides) average around 15 per annum. This compares with over 350 in the UK and presumably a relatively high figure for Australia.

Although there is a duty of care to maintain fencing at boundaries in locations of exposure - most efforts are futile, as determination of trespassers to gain access is most likely to succeed.

Due to Vandalism including missiles thrown at trains is a problem putting both passengers and train crews at risk.

Both of these problems relate more to social issues than the ability of railway operators to take mitigating action.

Vulnerability

Railway staff deaths and serious injuries appear to be the industry's greatest vulnerability in New Zealand.

Shunters track workers and train crews have the greatest exposure.

On railways generally the risk profile is one of many frequent occurrences having only minor consequences but the low likelihood of a catastrophic event cannot be ignored.

Effective Risk Management requires the recording of accidents. incidents and near miss situations with analysis of them as hazards to safe operations and their potential consequences.

High-risk situations cannot be ignored.

Vulnerability

Where the risk profile falls inside the ALARP bands, cost/benefit can *(MAY)* effectively be used to determine the appropriate investment levels for mitigation.

Although:

As has been seen as a result of the recent Paddington, London disaster rational approaches to benefit/cost analysis goes out of the door when the public sees the problem as being political - even when the railways are (in theory) privatised.

By having control of the minor incidents and near misses and implementing the resulting learning outcomes the chance of a major event should be significantly reduced. Major events rarely result from a single cause but usually from a combination of factors.

Vulnerability

The public is very averse to a major disaster but usually such an event will result from human error rather than from absolute technical failure or a failure to manage individual operational risks.

Investment therefore in company culture, management attention to significant messages from the "engine room", training, employee health, fatigue issues, substance abuse etc. is perhaps equally important to use of risk assessment alone.

It is therefore almost impossible to quantitatively state that regulatory intervention will stop a catastrophe happening and neither will the application of unreasonable sums of money.

However, the more we know about what is acceptable and what is not the better chance we have of making correct decisions on where to invest our money

Safety Analysis

A three level approach - High. Secondary and Low.

HIGH:

- relates to comparison of fatalities and serious injuries using "individual risk criteria"

SECONDARY:

- Serious occurrences such as derailments, collisions, level crossing accidents, SPADS (Signals Passed at Danger) etc.

LOW:

- Load falls, broken rails, track buckles, wagon defects etc.

The importance of each type of occurrence will vary from for individual railroads.

Safety Analysis (Individual Risk Criteria)

Count of Fatal Accidents.

Taking serious injuries into account:

Equivalent Fatal Accidents = (Fatalities + Serious Injuries/10)

Count of minor injuries is suspect - therefore ignored.

Individual risk criteria limits adopted

Exposed Group	Fatalities per annum		Equivalent fatalities per annum	
	Upper limit	Acceptable level	Upper limit	Acceptable level
Passengers	1 in 10,000	1 in 1,000,000	1 in 4,000	1 in 400,000
Staff	1 in 1,000	1 in 1,000,000	1 in 400	1 in 400,000
Public	1 in 10,000	1 in 1,000,000	1 in 4000	1 in 400,000

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Safety Analysis - Staff Lost Time injuries (LTI's)

A very easily compared meaningful statistic

Lost Time Injuries. Working hours lost due to injury.

Rate of LTI's hours lost per 200,000 working hours of total labour.

Full time employees work approx. 2,000 per annum the resulting figure approximates to a % of the workforce injured per annum.

Norfolk Southern Railroad has a rate of less than 1%.

Safety Analysis - Secondary Level Data

Recording of data is common.

Exchange of data between administrations is NOT.

Comparison IS difficult but should not be the reason for not doing it.

May cover a whole range of significant safety related parameters.

Individual administrations may have different significant parameters and will focus on what's important to them.

Safety Analysis - Low Level Data

Providing reliable data can be collected there is a case for collecting in the same way as for Secondary data. This is not proposed initially for information exchange but may be added later.

This can also incorporate "near miss" data.

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A Benchmarking Club?

More questions:

Are comparisons useful?

Is an information sharing circle attractive?

With our common interest in railway safety what are the impediments to information exchange?

Is the ALARP principle sufficiently accepted for fatalities and injuries to be reduced only to certain levels (not zero) as may result from a benefit/cost approach to risk mitigation?

Is it possible for us to get common definitions and use common normalisers for our individual data to be compared?

Do we at this meeting not represent an ideal forum for a common focus on comparison and benchmarking?

Do we have a will to get this to work?

Who should be the keeper of the "official secrets"?

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A Benchmarking Club?

This Group meets annually and has a number of common interests.

Eleven countries were represented in Sydney last year

We have an ideal opportunity to work towards recognition of international comparisons and benchmarks.

Need for recognition of common definitions and normalisers.

May be additional to individual agencies usual data presentation.

Need for a central repository of the data to analyse and distribute results.

NZ'S LTSA IS PREPARED TO TAKE ON THIS ROLE

Would NOT be judgmental - merely present findings and leave to interpretation by the individual agencies.

LAND transportsafety AUTHORITY

What data do we need to collect?

2) Numbers of fatalities and Serious Injuries to:

Passengers

Employees (Staff) including contractors

The Public

Trespassers (including suicides)

Public at Level Crossings (Vehicles and Pedestrians separate)

2) Lost Time Injuries.

Work hours lost - TOTAL or split by employment groups if available.

What data do we need to collect?

3) **Collisions**

Initially main line only but including train/train/hi-rail/track machine/overhanging load/open door etc.

4) **Running Train Derailments**

Main line derailments causing death or serious injury or causing damage in excess of US$10,000 (excluding recover costs)

5) **Level Crossing Collisions**

Between a train and a road vehicle.

Between a train and a pedestrian.

6) **Signals passed at Danger (SPAD)**

All instances of signal over-run by train except minor misjudgments

What data do we need to collect?

Also - as required:

Load falls

Broken Rails

Track Buckles

Signal wrong side failures

Accidents and Incidents in Rail Yards

Rules Breaches

Dangerous Goods Incidents

Incidents of Vandalism

Slips, Trips or falls

Assault on Railway Property

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Normalisers

Population of Area, State, Region Country etc..

Total numbers of staff, or by occupational group etc.

Total staff hours worked (for LTI Rate)

Passenger journeys.

Number of passengers exposed to specific routes or services.

Total train kilometres (passenger + freight) - or by miles

Passenger train kilometres

Freight train kilometres

Axle-kilometres (accounts for train size)

Passenger numbers x kilometres = Passenger km

Freight tonnes x kilometres = tonne km.

Land Transport Safety Authority

Normalisers

Numbers of level crossings (density per sq. km.)

Population of motor vehicles

See my detailed paper for suggested data to be collected.

The list is not exhaustive - could be added to or changed as appropriate.

Normalisers.

Whilst the more accurate the better, assessments could be acceptable if in the approximate order of magnitude.

Presentation of data

It is suggested the statistics be collected at 6-monthly intervals.

Presentation will be in the form of "League Tables" with no associated commentary.

Important NOT to encourage judgmental views on the meaning of the results.

The *limitations* of the comparisons must be understood by railway operators and regulators.

THEY must form their own views on what the comparisons indicate

BUT DO NOT DISMISS THE RESULTS AS BEING MEANINGLESS DUE TO APPLES WITH PEARS COMPARISONS.

LAND transport safety AUTHORITY

League Tables

Sample League Tables follow:

SEE HANDOUTS

Conclusion

New Zealand LTSA recognises a common desire amongst rail safety professionals to have a means of information exchange.

The LTSA is required by the NZ Government to measure rail safety in comparison with overseas "best practice".

The representatives here assembled annually for the International Rail Safety Seminar appear to be an ideal group to share information.

LTSA acknowledges the "imperfect" nature of the information collection suggested but suggests:

THIS IS NOT A REASON FOR NOT DOING IT

LAND transportsafety AUTHORITY

International Rail Safety Conference

1999 BANFF

19 October - 22 October 1999
Banff Springs Hotel, Banff National Park, Alberta, Canada

Paper 9907

Johan de Villiers

Developing a Rail Safety Regulator for South Africa

Publisher
2000 International Rail Safety Conference

CURRICULUM VITAE SUMMARY

FOR

JOHAN DE VILLIERS

Johan graduated with the degrees B.Sc.B.Eng. (Mechanical) at the University of Stellenbosch in 1965.

He started his engineering career with the South African Railways and Harbours immediately after graduation and worked in various divisions of the railway and harbours organistation.

Experience was gained in the maintenance of rolling stock and the manufacture of new rolling stock and of specialised rail infrastructure such as the high-speed turnouts used on the coal export line. He also worked as an engineer in the foundry on the mass production of cast iron items and the South African harbours in the design and building of new harbour craft.

He experienced the change from a Government managed railway to a commercial entity while working as Manager in Train Operations and later in Risk Management.

Presently he is in the fortunate position to put both his Risk Management and Train Operations experience into practice in a newly created department "Rail Risk and Quality". He is now responsible for Train Working Rules (Development, Implementation and Maintenance), Accident investigations, Safety management, Dangerous Materials Transport, Environmental management and Quality process development and implementation.

SPOORNET

DEVELOPING A RAIL SAFETY REGULATOR FOR SOUTH AFRICA

BACKGROUND :-

South Africa became a democracy in 1994. Soon after the new government was in position, rail operations became the focus point of discussions in an attempt to find ways to reduce state financial assistance and to fund the urban rail commuter services as well as to improve efficiency and effectiveness of the current rail services which are gradually declining in financial viability.

Spoornet is South Africa's largest railway asset owner and operator. The present (June 1999) position is :

± 2 700 locomotives
± 110 000 wagons
± 44 000 employees
± 22 000 route kilometres

The only other major rail operator is Metrorail Metrorail operates the suburban train services is in the 6 major South African Cities. Namely Cape Town, Durban, East London, Johannesburg, Pretoria and Port Elizabeth.

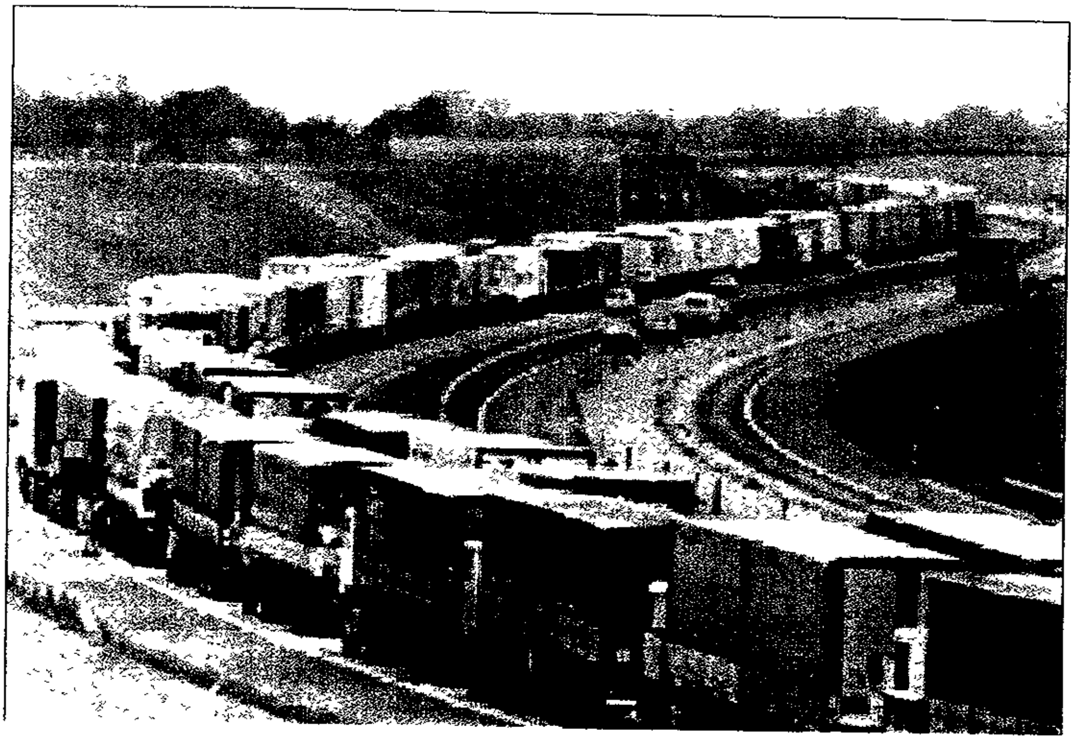
METRO PHOTO

SPOORNET

Besides Spoornet and Metro there are other small-localised rail operators and/or asset owners

Rubberwheel transport is well developed. In fact the position at the moment is that the roads are deteriorating due to the extensive use of heavy road vehicles

HEAVY ROAD VEHICLE PHOTO



SPOORNET

South Africa also has vast areas where the transport systems are either under developed or under utlised Combi's (with seating for ± 8 to 12 passengers) are in their thousands on the roads and are filling in to supplement the need for mass transport.

TAXI PHOTO

Government's decision :-

Government decided on two basic actions that are of interest for this discussion

- The development of a new Land Transport Act to regulate all modes of land transport both for the conveyance of people and goods
- The consessioning of some of the railway operations. The focus on consessioning is the mass transport of people

During 1997 the National Department of Transport (NDoT) approached Spoornet to support government actions with the expertise to develop a Railway Safety Regulator It is believed that a Railway Safety Regulator (RSR) would open the door to :-

- Relieve the pressure from road users that are insisting that the playing field between road and rail should be leveled

SPOORNET

The proposed Land Transport Act describes extensive measures to regulate and control rubberwheel transport Some of these measures will inevitably result in out of pocket funds for the vehicle owner and/or the operator

- Control the safety risks associated with consessioning. Metrorail presently has the "right" to be the sole metro operator but this "right" expires three years from inception date. The vision to have the first consessions allocated in a few years time is a lively discussed subject in our newspapers at present.

  Spoornet was assigned the task to develop the concepts for the South African RSR

Basics for the South African RSR

The National Department of Transport (NDoT) had the following prerequisites for Spoornet's participation in the development of the RSR.

- NDoT do not at present have railway expertise in their structures. They will rely on the Spoornet expertise but retain the right to buy in expertise from elsewhere (overseas?) to test recommendations,
- they retain the right to veto/accept any of the Spoornet proposals,
- two observers, nominated by NDoT had to be accommodated in the process This translated into the creation of a Task Team, and
- the emphasis is on railway expertise and not on Spoornet. The fear is that the other railway asset owners and/or operators might react negatively if Spoornet is identified as the driving force behind the RSR.

The Task Team's proposal that the absolute minimum should be legislated and that the rest of the RSR development should be worked through regulations as appendixes to the act was accepted.

RSR framework :

The South African RSR will operate within the framework of the Principles for Safe Movement on Rail. (POSMOR)

These principles were presented to this Conference in 1997 in Lucerne Switzerland and with the exception of one or two of the delegates offering improvements no one commented negatively

(For the sake of refreshing memory POSMOR is attached to this document).

SPOORNET

It was approved that within the framework provided by POSMOR the RSR shall have the following responsibilities -

- Receive Rail Safety Charters from all involved parties

  A Rail Safety Charter shall describe the nature of the rail related activity and the measures in place to manage operational safety.

- Do Safety Audits on the basis of the Rail Safety Charter

- Do incident/accident investigations.

- Agree on safety performance standards and safety performance improvements. This shall be done during negotiations between the RSR and the rail asset owner/operator.

With this written into the act the Land Transport Act will be presented to the Minister of Transport to be signed and promulgated.

COPY OF PART 12 OF THE LAND TRANSPORT ACT

RAIL SAFETY

70. *Appointment of Rail Safety Regulator*

(1) ***The Minister shall appoint a Rail Safety Regulator under the control of the Minister.***
(2) ***The Regulator shall make known his or her physical and postal addresses by notice in the Gazette.***
(3) ***The function of the Regulator shall be to take steps to enhance the safety of rail operations and lay down operational requirements relating to rail safety, and shall perform the other functions conferred on him or her in terms of this Act or by regulation.***
(4) ***The Regulator shall liaise regularly with the Department of Labour and take into account the provisions of the Occupational Health and Safety Act, 1993 (Act No. 85 of 1993) in performing his or her functions.***
(5) ***The Director-General shall, subject to the laws governing the Public Service, provide the staff necessary to assist the Regulator in the performance of his or her functions.***

71. *Regulations*

The Minister may make regulations or issue guidelines at the request of the Regulator related to –
(a) ***principles for safe movement on rail in order to provide the railway industry with rail safety standards;***
(b) ***the sustainment of safety management principles;***
(c) ***the auditing of safety management systems;***
(d) ***the investigation of incidents and accidents and the analysis of incident and accident tendencies;***
(e) ***any other matter the regulation of which may be necessary or desirable in the opinion of the Regulator to achieve or promote the objects of this Part of this Act.***

SPOORNET

THE WAY FORWARD :-

With the abovementioned few items legislated in the act it is quite obvious that the RSR activities can not be "switched on". The RSR in person or office is not yet in existence. It however provides the empowerment for the further development of the RSR It is also considered that these few concepts creates an extremely powerfull base for a future RSR with muscle to regulate railway safety.

The way forward is seen as :-

- Phase one :- Establishment
- Phase two :- Growth/development
- Phase three .- Implementation

The time frame for the project will be 24 to 30 months

ESTABLISHMENT

The starting blocks are of multiple origin all leading to the planned eventual successful establishment of the RSR.

Flowline one :-

- Identify the detailed activities that will be necessary to implement and operate the RSR in the initial phases.

- Write job profiles from the identified activities, evaluate and determine the "value" of each defined job.

- Design employment and/or buy in service contracts.

- Advertise and interview candidates and select individuals suitable for employment or for service contracts.

Flowline two :-

- Identify cost drivers such as salaries, office accommodation and equipment, transport, auxiliaries and budget

- Get budgeted funds approved

Flowline three :-

- Develop the work processes and procedures that will have to be applied/followed by the RSR employees and/or contractors.

- Develop training material New appointees will not automatically know what to do, and to get a newly appointed team of people to work on a new task is in it's own a formidable task

- Develop the supporting documentation that will be used in the processes and procedures. The RSR will need documentation to, for example, give notice of an audit or investigation Ways must be designed to deal with the formalities in a way that reflects the RSR's position and that will in no uncertain way express the need for the required action.

GROWTH/DEVELOPMENT

Again, as with the first phase it is clear that a number of issues require development simultaneously

Flowline one :-

- Negotiate with other Government departments to clear out exactly how the RSR will fit into the legislative scenario NDoT and the National Department of Labour (NDoL) both legislates safety. NDoT focus on land transport operations and NDoL on employee health and safety It is obvious that there will be overlaps and even clashes in interrests – as far as it is possible these need to be identified and cleared.

Flowline two :-

- Negotiate with all other railway asset owners and operators and educate them on the role of the RSR and on what will be expected of them The small operators i.e the owner of one locomotive or a small siding owner are bound to find the RSR problematic if they are not coached before hand Up to this stage the interrest displayed by the smaller roleplayers have been dissappointing They argue that rail operations are not their core business and thus warrants little attention.

Flowline three :-

- Continue and complete training of newly appointed employees and initiate the involvement of these employees in the RSR development processes.

SPOORNET

IMPLEMENTATION

- Increase the execution of RSR activities. Employees should by now be more competent.

- Eventually move to full "switch on" This is the stage where the RSR office should have enough momentum to continue without "crutches" provided by the Task Team.

- Initiate the processes to generate income through RSR activities in order to move the RSR from the NDoT budget to a selfsustained agency of NDoT This facet opens up a new scenario but it is hoped that the RSR will by now be firmly in position and will have the abilities to do further development inhouse.

CONCLUSION :-

The Team working on this task consulted with a number of overseas governments and railways where RSR's or similar positions are operational. Most of those consulted can talk on the execution of RSR tasks but very little advice could be obtained on how best to establish the RSR, starting from zero.

It is the intention to continue to consult with established RSR's. Ideas as to who will be the best to talk to will be appreciated. It is recognised that the process have at least two sides – that of the RSR that will have to apply the legislation and the other side i.e. the rail industry that must respond by delivering as the act requires

I thank you.

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1999 BANFF

19 October - 22 October 1999
Banff Springs Hotel, Banff National Park, Alberta, Canada

Paper 9908

Victor Coleman
Charles Erasmus
Rakobela Matshoge

Plenary Session "A"
The role of Government Regulation

Note: A short paper formed the keynote discussion paper for Plenary Session "A". 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

BRIEF BIOGRAPHY

VIC COLEMAN, HM CHIEF INSPECTOR OF RAILWAYS

Vic Coleman has been HM Chief Inspector of Railways since July 1998, having previously been HM Deputy Chief Inspector responsible for the field operations of HM Railway Inspectorate (a division within the Health and Safety Executive).

Vic has more than 25 years experience as one of HM Inspectors enforcing health and safety legislation across a wide range of industries. He has investigated major incidents on the railways, in the chemical industry, in the construction industry and in manufacturing. He has also acted as prosecutor for cases in magistrates courts on occasions too numerous to mention. He was the Inspector responsible for putting together the prosecution case which led to the conviction of the British Railways Board following the serious railway accident at Clapham Junction in December 1988.

Vic led the team which wrote "Ensuring safety on Britain's railways" which was adopted by the Health and Safety Commission and the Secretary of State for Transport as providing the blue print for safety arrangements on the railways following privatisation of BR.

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Issues paper for debate in plenary session 'A'

THE ROLE OF GOVERNMENT REGULATION

There are many ways in which Governments have sought historically to regulate and supervise railways in their own countries.

Governments may seek to:

a) set standards

b) investigate accidents

c) investigate complaints

d) check compliance by inspection

e) license operators

f) impose operational restrictions

g) register competent personnel

h) *promote public safety by campaigning*

i) run the railways itself

j) enforce relevant health and safety law

.... and so on

To achieve some or all of these, they may set up different bodies, including regulatory bodies.

There are some significantly different models in existence in different countries, for example:

a) "Regulation" is separated from independent accident investigation by government agency

b) all/most governmental safety functions are brigaded into a single *regulatory body*

c) Government simply charge the railway companies to run the railway with no external regulation as such.

In most cases it is implicit (at least) that the prime responsibility for safety rests with the company running the railway but the growing trend to fragment railways (in particular to separate infrastructure control from train operation) and to regulate for *risks inevitably leads to some kind of division of responsibilities in practice.*

Issues for debate:

- What is the optimum balance for allocation of responsibilities?
- does governmental regulation add value with respect to the proper control of risk? and, if so, in what ways?
- what do railway companies/operators look for in a safety regulator?
- what do railway safety regulators look for in the approach of railway companies/operators to regulation?
- what is the role/function/value of formal enforcement or the seeking of judicial penalties (eg by prosecution).
- does separation of functions in different organisations bring conflict or inefficiency - or greater accountability and focus

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International Rail Safety Conference

1999 BANFF

19 October - 22 October 1999
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Paper 9909

Victor Coleman

The Safety Implications of Growth in the Railway Industry

Publisher
2000 International Rail Safety Conference

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THE SAFETY IMPLICATIONS OF GROWTH IN THE RAILWAY INDUSTRY[1]

By Victor Coleman, HM Chief Inspector of Railways, Health and Safety Executive, Rose Court, 2 Southwark Bridge, London, SE1 9HS, UK.

Abstract

After a period of relative decline, railways in Britain and in many other parts of the world are growing again. The paper describes some of the potential safety implications of growth - both the threats and opportunities - and will outline what the author considers to be key aspects of programmes to ensure that threats remain unrealised and opportunities are seized. It is concluded that growth is to be welcomed but that it has to be a properly managed process.

Growth and Change - fundamentals

1 Growth is merely one manifestation of change. And change is inevitable. It is not something to be frightened of. In fact it seems likely that stagnation is just as likely to bring safety problems as change. And if change is inevitable, then growth appears to offer many advantages over decline or stagnation.

2 Any process of change brings risks - the key issue is to ensure that such risks are managed and controlled.

[1] Paper to be presented at the 1999 International Railway Safety Conference, Alberta, Canada, 19 - 22 October 1999

Growth and change - the British experience in the 1990s

3 In 1990 it would have been easy to describe the mainline railways in Britain. It was, essentially, all owned and operated by British Railways (BR). They owned and operated all the infrastructure (track, trains, stations, signalling, workshops, communications, power distribution etc) and they also designed (and, through a subsidiary company) built rolling stock. Some rolling stock was procured from independent suppliers and there were significant fleets of privately owned freight wagons but BR was virtually as near as one could imagine to providing a monopoly, and oligarchical, railway service. Which is not to say that it had a stagnant management structure. Reorganisations were endemic and the shortcomings in managing such changes were heavily criticised in the judicial inquiry report following the major train accident at Clapham Junction in 1998 (a collision, resulting in 35 deaths). And if one were to characterise BR's prime task in its final years it was to manage decline and ensure that degradation was, at least, graceful!

4 In 1992 the British Government decided to privatise the main railway network - Annex 1 describes the present structure - the BR monolith has spawned, in all, nearly 100 different "daughter" organisations!

5 In more recent years the utilisation of the railways has increased at a significant rate - bucking the theory that this was directly linked to changes to Gross Domestic Product! Passenger kilometres were up 7% in 1997/98 and freight tonne kilometres rose by 12%. In the first 6 months of 1998/99 freight traffic grew by 16% and the largest freight company operating in Britain, EWS - a subsidiary of Wisconsin Central Transportation, aims to treble its business in 10 years. The Railway Forum (a "ginger group" for the railway industry in Britain) expects:

- 1950 new passenger coaches in service by 2002
- investment of £20bn (US $32billion) over 5 years in Britain's railways
- £1bn (US $1.6bn) spent on refurbishing stations by 2001
- by 2002 half of the passenger fleet will be either new or refurbished
- to continue running 1000 additional services a day
- a new high-speed link from London to the Channel Tunnel
- introduction of high-speed tilting trains

and so on.

6 So change is inevitable and, for us in Britain at least, continuous. It is undeniably a major challenge.

The Nature of Growth

7 For the purposes of this paper, I propose to treat "growth" as:

- getting BIGGER
- getting *better*
- or simply "maturing"

What are the Threats associated with Growth

8 I start looking at threats by considering an example which seeks to answer the question "does more traffic without any increase in capacity lead to more risk?". In a dense network such an increase would appear to lead, inevitably, to a situation where trains approach signals at danger more often. If one were to postulate (as many have in the past) that there is a direct relationship between the number of times drivers approach signals at danger and the number passed at danger then growth might be said to increase the chance of signals being passed at danger (SPADs). Even if one does not subscribe to the theory that there may be a fixed probability (overall) of passing a signal at danger this is certainly a valid factor in my experience.

9 Nor is it just the increasing likelihood of passing a signal at danger - a denser network will tend to increase the chance of coming into collision with another train if a train runs through the "overlap" at a signal.

10 Other specific threats from growth may include:

- less separation of track workers from trains
- in degraded modes - conditions can deteriorate more rapidly
- potentially faster build up of congestion at stations
- more people to evacuate
- possible knock-on effects of road safety and congestion (eg level crossings which rarely open to road traffic)

I am sure that others can imagine many more!

11 On an organisational level, change generally can overwhelm weak organisations. The pressures on people can build and bring conflicting messages about priorities. This can lead to corners being cut and nothing being left in reserve for the unexpected (the unexpected is, of course, one of life's great certainties!). In short, growth - or more accurately unmanaged growth - makes the whole system less forgiving of failures, and failures may be more likely to be punished.

Growth - the opportunities

12 Growth is certainly not all about increasing risk - it also brings many opportunities:

- growth, and the anticipation of growth, drives the need/desire/commitment to improve capacity and systems
- investment can/should lead to improvements in risk control eg - the West Coast Main Line project in Britain is driven by "growth" but the planned introduction of transmission based signalling not only offers greater capacity/speeds but also Automatic Train Protection (ATP) - almost as a by-product
- growth in railways implies less growth in road traffic? (- arguable at least!)
- it provides opportunities for organisations to review and re-invent themselves - against a positive outlook for the future (which is at least more encouraging than change driven by decline!)

Ensuring Growth is good!

13 My view is that growth of railways is good, for example:

- travelling by rail is 15 times safer than travelling by car in Britain based on distance travelled (and 5 times safer than travelling by bus or coach on the same basis)
- a high speed train uses only half the energy of a car per passenger-kilometre
- moving a tonne of freight by rail produces 80% less carbon dioxide than moving it by road
- a motorist can have one or two beers and still travel safely by train as a passenger!

and so on!

14 The potential negative effects will only be realised if positive and effective steps are not taken. The key processes are familiar to anyone who has had to manage change. It is essential that the processes involved in securing growth are:

- UNDERSTOOD
- ASSESSED
- MANAGED
- MONITORED
- REVIEWED

15 So what needs to be understood? Not just the growth in the business but its consequences in terms of risk, and taking into account all the relevant ramifications of growth. Also the processes involved in driving growth and in managing possible adverse consequences.

16 Assessment of causes and effects builds understanding and together these provide the basis of management of the process and potential problems.

17 The aim, in risk management terms, is to neutralise as many risk factors as possible and, where they cannot be so neutralised, to mitigate the adverse effects. If one can keep overall risk exposure steady in a growing industry, individual risk will effectively fall. This needs to be the minimum goal - in railways (as in aviation) the public see the gross harm (in, say, overall numbers of casualties or incidents) rather than individual risk exposure as being the prime concern. So, growing railways <u>need</u> to do better.

Regulatory Requirements

18 Key changes to British law and regulatory requirements were made to deal with the major change to the railway industry on the break-up and privatisation of BR. The safety case regime, established by the Railways (Safety Case) Regulations 1994, emerged as a result of recommendations contained in a major report, "Ensuring Safety on Britain's Railways" (ESOBR) which was submitted to the Secretary of State for Transport by our Health and Safety Commission. This report developed proposals for ensuring safety following the liberalisation of access to and privatisation of British railways and the way forward was accepted by the Government and Parliament. Certain principles were set out in that document as governing the establishment of a framework of control for railway safety during this period of major change and subsequently. These principles were:

- any system which emerges must not lead to any diminution of current safety standards. It should, as far as possible, facilitate any necessary improvement of those standards. It should be practical and able to deliver appropriate and effective control of risk;

- the prime responsibility for ensuring safety on the railway must rest with the party (or parties) who has (have) control (but this responsibility is limited to the extent that they actually have, or ought to exercise, that control);
- the degree of statutory control shall be the minimum consistent with the need to ensure adequate and cost effective levels of control of risk and to secure public confidence;
- any arrangement should be demonstrably fair to all parties involved; and
- legislation pertaining to railway safety should be administered by a single, independent safety regulator, the Health and Safety Executive (HSE) - of which HM Railway Inspectorate (HMRI) is a part.

19 Other principles were derived which governed the development of new regulatory arrangements:

- safety systems on the railway must address technical, operational and organisational issues;
- duties and responsibilities (of organisations and individuals) must be adequately defined;
- within the limits of their control, the infrastructure controllers will bear primary responsibility for the co-ordination of measures to control risk on the railway; and
- there must be effective co-ordination and co-operation between all parties and individuals.

20 It was accepted that HSE/HMRI would continue to enforce the basic protective legislation - which covers all aspects of railway safety - by means of planned programmes of inspection and investigation involving all parties operating on the railway network. Any new proposals were intended to concentrate on the need to establish whether a new operator or organisation (or one who intends to work a significantly different operation), whether operating trains or stations, has the will, capabilities, organisation and systems to operate safely right from the start. It was proposed that each railway undertaking should produce a railway safety case (RSC) which would set out the undertaking's policy, risk assessment, safety management system, maintenance and operational arrangements (in so far as they relate to health and safety issues) - Annex 2 is a summary of the required contents of a Railway Safety case. It was also proposed that the RSC of each operator and infrastructure controller should be subject to a "validation" process (to verify the likely effectiveness of the RSC) undertaken by a second or third party before operations on the railway could commence.

21 ESOBR considered that it was appropriate that an infrastructure controller should undertake the validation of the RSC of operators who wished to run train services or stations on the network controlled by that body. It was deemed essential that the infrastructure controller should be in a position to satisfy himself that those who were to operate on its network would do so safely. However, this proposed validation procedure needed to itself be subject to scrutiny and acceptance by HSE "as the independent safety regulatory body". In practice this was to be done as part of a wider validation of the infrastructure controller's RSC by HSE. It was an essential feature of the new legislation that each railway undertaking was to be required to work in accordance with the agreed RSC and that significant modifications would themselves need to be subject to a level of scrutiny similar to the original "validation".

22 Given the vital importance of managing safety at the very numerous interfaces which now exist on Britain's railways it was a very clear recommendation that the arrangements between parties should recognise a need for operators to comply with the reasonable directions of the infrastructure controller as regards safety on the railway system, and the need for the infrastructure controller to monitor (and audit) the performance of operators and compliance with relevant RSCs. HSE's view is that such arrangements do not detract from the HMRI role as the operational part of the single safety regulator, they do, however, require the infrastructure controller to ensure that the risk imported onto their railway network is acceptable and they are required to monitor that the safety criteria that they define are being met by train operators and other duty-holders on their network. The functions and responsibilities set out by the specific legal requirements enable the infrastructure controller to meet its responsibilities under the law generally.

23 The processes established to deal with the new railway industry structure also enable the consequences of growth to be managed. In particular, the regulatory requirements of British law would require (in dealing with growth) railway operators to:

- review and revise risk assessments
- review and revise safety cases
- apply rigorous change management processes
- take advantage of any opportunities to improve control of risk
- monitor and review

The Safety Experience

24 So what has been the safety outcome of all this change and growth? In general the British railway industry has maintained the downward trend in risk exposure. In spite of the growth reported above the numbers of train accidents fell in the year 1998/99 and the numbers of such accidents on or affecting passenger lines were at record lows in the last 3 years. Last year, for the first year since privatisation, no passengers on a train were killed in any train accident. This is not to say that everything is as encouraging.- for example incidents caused by malicious action are an increasing concern, and infrastucture maintenance still does not deliver what we all want. Mostly this is growth independent but at least one area of failure concerned the inability of the infrastructure controller to take adequately into account increased usage on parts of the network when devising and managing maintenance activity.

Conclusions

25 Change may be inevitable - accidents are not!

26 Growth, like all change, presents challenges and needs careful consideration of process and potential consequences. It also needs sound management so that beneficial effects are realised and negative ones avoided.

Version 2.0 - August 1999

ANNEX 1

Railway Privatisation in Britain - how BR transmogrified into a series of new organisations

A1 In the run up to the start of the privatisation process BR was subject to very significant restructuring to create an organisation the parts of which could migrate into fully independent vested entities which would transfer, progressively, to private sector control. Railtrack plc became the owner and controller of the former BR infrastructure.

A2 Those responsible for maintenance and renewal of infrastructure were broken up into organisations working under vary many separate contracts which have now all been incorporated into larger structures and associated with companies active in other parts of the construction/contracting industry.

A3 Train and station operations were allocated to 25 separate train operating companies (TOCs) who were subject to bids from those who wished to operate the TOCs under franchises granted by the British Government's Office of Passenger Rail Franchising (OPRAF).

A4 The passenger rolling stock passed into the ownership of 3 rolling stock companies (ROSCOs).

A5 Different freight companies were created (and endowed with BR's wagon fleet) and there have been further changes since with most freight now being carried by English, Welsh and Scottish Railways and Freightliner (now joined by another small new entrant freight company).

A6 Various other BR central design, technical support, research and management organisations were transformed into independent consultancies which have themselves now entered the private sector (eg British Rail Research is now a part of another recently privatised company AEA Technology Ltd - itself formally part of the UK Atomic Energy Authority). New train equipment supply companies (TESCOs) were also created.

A7 In addition, there were, and remain, very many freight wagons owned by 'private owners' which continue to be hauled by freight train operators. Build and maintenance of these has continued to be contracted out and, in addition, there is increasing use across the whole of the industry of other contractors (eg for vehicle maintenance, design work, project management etc.).

A8 Moreover there remains a relatively small, but far from negligible, passenger charter and specialist excursion train market (eg the Orient Express operation) and there is inter-running with trains of other operators (eg London Underground Ltd) who are infrastructure controllers and train and station operators in their own right.

ANNEX 2

The Contents of a Railway Safety case

The particulars[2] to be included in a safety case are set out in schedules to the Railways (Safety Cases) Regulations and can be summarised as follows:

i	the name and address of the duty-holder
ii	a description of the operation
iii	a general description of premises, plant intended to be used..
iv	particulars of any technical specifications, and procedures or arrangements relating to operations or maintenance ... insofar as they affect the health and safety of persons.
v	a statement of the general policy of the duty-holder with respect to the health and safety of persons affected by the operation ... including the health and safety objectives he intends to achieve ...
vi	a statement of the significant findings of ... risk assessment ...
vii	particulars to demonstate that the management system of the duty holder is adequate to ensure that the relevant statutory provisiond will ... be complied with ...
viii	particulars to demonstrate that there is an adequate organisation for carrying out the policy (as at 5 above) and adequate arrangements for ensuring the competence of employees ...
ix	particulars of adequate arrangements for passing information ...
x	arrangements for consulting employees
xi	particulars to demonstrate that the duty-holder has established adequate arrangements for investigating accidents and other incidents which could endanger persons, for co-ordinating such investigations with (and for participating in) the investigations carried out by other railway operators

[2] adapted from schedules to the Railways (Safety Case) Regulations 1994

xii arrangements for managing work carried out by people who are not employees of the duty-holder but who carry out work in relation to premises or plant which the duty-holder owns or controls (eg contractors).

xiii procedures for dealing with accidents and emergencies or other incidents which could endanger persons.

xiv (for station safety cases) procedures and arrangements relating to movement, over-crowding and evacuation of people in stations.

xv safety procedures relating to design and procurement of premises and plant.

xvi arrangements for audit, and audit reports.

xvii arrangements to achieve co-operation between the various industry parties.

In addition, each safety case for an infrastructure controller must contain particulars of arrangements for scrutinising any safety cases of train and station operators submitted to him and the criteria to be used in relation to acceptance - also the arrangements for ensuring that such train and station operators follow the procedures and arrangement in their respective safety cases.

End.

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Paper 9910

Koichi Kawano
Yoshihiro Kimura

Safety Plan 21: Safety Policy for the 21st Century

Publisher

2000 International Rail Safety Conference

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Born on July, 1953

EDUCATION

Tohoku University, in Electrical Engineering, March 1978

PROFESSIONAL EXPERIENCE

April 1978 – March 1987
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April 1987 – present
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1999 INTERNATIONAL RAIL SAFETY CONFERENCE

OCTOBER19－22, 1999

ALBERTA CANADA

Safety Plan 21

— Safety Policy for the 21st Century —

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"Safety Plan 21 - Safety Policy for the 21st Century -"

JR East has steadily improved its safety level through various plans including "First Safety Investment Plan (5-year plan)" and "Basic Safety Plan (5-year plan)". It is also a fact, however, that some accidents still occur resulting in the death and injury of customers and employees. (See Separate Sheet 1)

In order to fulfill its growing social duty and to satisfy its customers' expanding expectations, JR East has an important role to build up a safer railway operating system and to improve the quality of train operation.

To accomplish these goals, JR East has started the five-year plan, "Safety Plan 21," for the five years of fiscal 1999 to fiscal 2003.

"Safety Plan 21" is to respond appropriately to the changing view of the customer, to the progress of technology, and to a drastic change in the employee configuration. This plan is also to permeate an independent spirit through JR East under the current situation that corporate actions coming from the company's own responsibility are strongly desired.

Therefore, for the 21st century, JR East responds to the trust and the expectation of customers and employees. JR East works hard to accomplish ZERO accidents which cause customers' death and injury and employees' death, focusing on the following four main points. (See Separate Sheet 2)

○Intensive installation of safety facilities

○Raising the level of safety - the prevention of serious accidents, and the accomplishment of the steady train-running with no delay

○Appropriate response to various kinds of changes

○Rebuilding a safety culture

1. Future Safety Measures

(1) Intensive installation of safety facilities (See Separate Sheet 3)

The planned installation of safety facilities conducted until now has greatly contributed to the improvement of safety. Considering the possibility and the seriousness of the accidents, JR East systematically improves safety facilities to accomplish ZERO accidents which cause customers' death and injury and employees' death or which are liable for JR East itself. In making the installation plan, JR East has a perspective which encompasses all the sections of JR East. This perspective is based on the analysis of the current system of train operations and maintenance works.

① Upgrade of conventional measures

-Complete installation of train collision prevention measures-

Things to be done are:
- completion of ATS-P phase-IV installation
- installation of a new function of speed verification into the lines with ATS-SN
- further installation of an ATS-SN device which prevents wrong departure

② New measures

-Guarantee of safety during maintenance work -

JR East takes some measures to prevent accidents resulting from mistakes during maintenance work and to prevent labor accidents (the ones caused by train-hitting) of employees including cooperating-companys' employees

-Prevention of the mis-operation of train doors and the customers' being caught between doors

JR East takes intensive measures, including technological development, to prevent mis-operation of train doors at a place with no platform and to prevent customers from being caught between doors.

-Measures which hadn't been considered for systematization-

With reviewed work and technological development, JR East takes measures to prevent the following things:
- excess of train speed in a section where speed is temporarily limited
- unexpected movement of parked cars
- mis-operation of the lever which operates a level-crossing manually

③ Measures to prevent accidents concerning the maintenance of rolling stock and infrastructure

JR East takes measures to prevent axle breakage, the falling off of rolling stock parts, gauge expansion, non-lowering of crossing gates, and wrong signaling.

④ Measures to prevent accidents at station platforms and at level-crossings

Station platforms and level-crossings are unique areas to train operation because they are related to the human factors of passengers and car drivers. In order to guarantee safety at a platform, JR East promotes current measures to prevent passenger-falling and train-hitting at a platform. JR East also studies a new measure to protect passengers at a platform effectively. In order to guarantee safety at a level-crossing, JR East is further installing a detector to detect obstruction at a level-crossing. In addition, JR East installs thicker crossing gates and European crossing gates to improve the ability of a level-crossing to protect. Monitoring cameras are also installed into level-crossings to watch for illegal crossers and to report them to the police. Furthermore, through the regular campaigns concerning platforms and level-crossings, JR East tries to acquire the understanding and the cooperation from its customers and the public.

⑤ Measures to prevent accidents caused by natural disasters

To prevent accidents caused by natural disasters, JR East studies accurate operation in accordance with rainfall, and is developing a new detection system for landslides and wash & delve of a bridge pier. JR East also takes extra preventative measures for important lines.

(2) Raising the level of safety - the prevention of serious accidents, and the accomplishment of the steady train-running with no delay -

JR East has always considered safety a top priority. When an accident occurs and the train running isn't in order, the train operation depends more on human ability because unusual instruction and information must be processed properly and immediately. This may result in human errors, according to data collected from past accidents. Therefore, it is essential to prevent accidents by doing properly the basic actions, such as preventing the malfunction of rolling stock and ground facilities and stopping trains immediately in a dangerous situation at a platform or at a crossing. The prevention of accidents by basic actions achieves the minimum disorder of train operation, which leads to steady train operation and consequently makes the safety level higher. With the growing customer expectation, JR East needs to make train operation as steady as possible. In order to improve the safety level, it is vital for JR East to keep steady train operation as well as to prevent serious accidents.

(3) Appropriate response to various kinds of changes

① Reformation of train operation system

***Train operation system with no station employee**

It should be considered that shunting work at a station is to be rearranged, that a large part of train operation becomes automatic, and that many station employees who deal with signaling become older and the number of them is getting smaller. Taking those situations into account, JR East tries to achieve a train operation system with no station employee. The measures to be taken are:

- further installation of CTC and PRC
- having a large station controlled by a central operation center through CTC
- reviewing various kinds of work and reconstructing them
- technological development

***Provision of information for train crews**

Much information related to the safety of train operation is currently based on the crews' ability to memorize. Therefore, the method of transmitting information is unskillful, and the reliability of the information itself may not be very high. Taking these facts into account and considering the human factor of train crews, JR East is developing a new system which effectively provides train crews fixed information (signal positions, etc.) and changing information (instruction from an operation center, etc.), creating a higher level of safety.

*** Measures to respond to the increasingly important role of the dispatcher**

The future role of dispatchers in a central operation center has become more important because of the qualitative change in operation management and the expansive installation of ATOS system. Therefore, JR East improves the train operation management in the following ways.

- rearrangement of the dispatcher organization
- upgrade of dispatcher facilities
- personnel education
- improvement of the ability to deal with any troubles
- review of driving instruction

② Training of young employees

With the increasing number of young employees hired in the Heisei era (1989~), JR East strives to train the young employees who will have important roles in their future work. The measures to be taken are:

- appropriate training and understanding for each individual
- education of the social discipline as a member of society
- improvement of the support system and communication
- creation of a life cycle
- improvement of the quality of educating and training

③ Inheritance of veterans' skill, and response to new technologies

A mass retirement of veteran employees is to come soon. Since the veterans have a lot of special skills earned by their own experience, it has become a critical and urgent issue for the younger generation to inherit veterans' skill and know-how. To solve this issue, it is necessary to focus on basic principles of railway facilities which maintain safety operation, and on basic technologies unique to railway. JR East extracts the special skill and know-how that need to be inherited, and improves the training and educating system for inheritance. JR East also installs actively computerized equipment and maintenance-free facilities. Furthermore, JR East supports a challenge to acquire the certification of ISO 9000 Series.

JR East works on systematizing Shinkansen maintenance work and on establishing a medium-term plan concerning the safety for cooperating companies.

④ Safety concerning freight trains of JR Freight

As for the safety of freight trains, JR East keeps demanding that JR Freight should take measures to prevent serious troubles of parts (axles, bearings, etc.) unique to a freight car and that JR Freight should install the ATS-P system into their cars. JR East also promotes the cease of entrusting and being entrusted concerning train crews and cars.

(4) Rebuilding a safety culture

① proper understanding of accidents

It is important to recognize again that the proper understanding of accidents is the first step to create a measure to prevent re-occurrence of the accidents. Therefore, it is fundamental to create a safety culture in every working place in JR East.

○ In order to determine the cause of an accident properly, it is important not only to focus on the result of the accident but also to improve the ability to analyze background factors resulting in the accident from the aspects of related facilities, the handling by employees, education, training, rules and so on.

○ It is also essential to ensure that the stressed determination of the cause doesn't result in a loss of awareness concerning the importance of employees' duties.

② Independent safety-seeking activities of each employee (Challenge Safety activities, etc.)

It must be recognized that no matter how many measures are taken for railway facilities, the prevention of accidents depends ultimately on people who use those facilities. It is essential for each employee to follow basic actions properly and to improve the recognition of safety.

Ten years have passed since Challenge Safety activities started, and great disparities have emerged among CS activities in JR East. There are many problems such as mannerism, self-satisfaction, non-participation of some members, and inappropriate selection of the theme. In order to overcome these problems, it is necessary to take the CS activity as a long-term one and to keep making an effort to create new approaches.

【Separate Sheet 1】

Results of Past Measures

■**Intensive installation of safety facilities**

- Installation of safety facilities based on a five-year plan
- Research and development of modern systems which deal with railway works depending on individual ability to pay attention

■**Independent safety-seeking activities of each employee**

- Expansion of Challenge Safety activities
- Appropriate education concerning the basics of safety

■**Organizational operation considering the safety in advance**

- Determining the cause of accidents accurately, and taking measures to prevent them
- Enriching and activating safety-management and work-accomplishment organizations

■**Appropriate response to the change of the environment surrounding railways**

- Appropriate response to applying new technology
- Handling of various changes in terms of social values, increasing older people, etc.

■Five-year plan has been carried out almost according to the schedule
(The amount of investment is about 470 billion yen for fiscal 1994-1998)

■The installation of ATS, safety system for level-crossing, PRC, train-radio, etc. is getting the same level of the installation of major private railways

■A new turn of Challenge Safety activities (executed January 1995)

■Training of instructors who teach about safety, and teaching employees various kinds of skills and technologies.

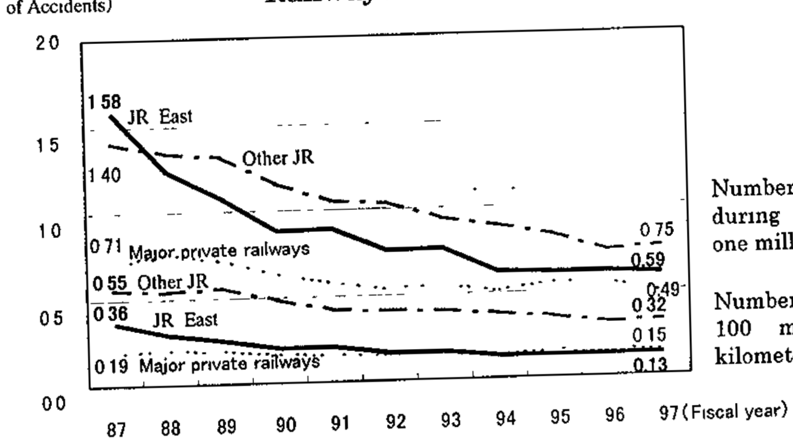
■Promotion of investigation of accidents, finding out the cause of them

■Construction of an advanced database system for railway accidents

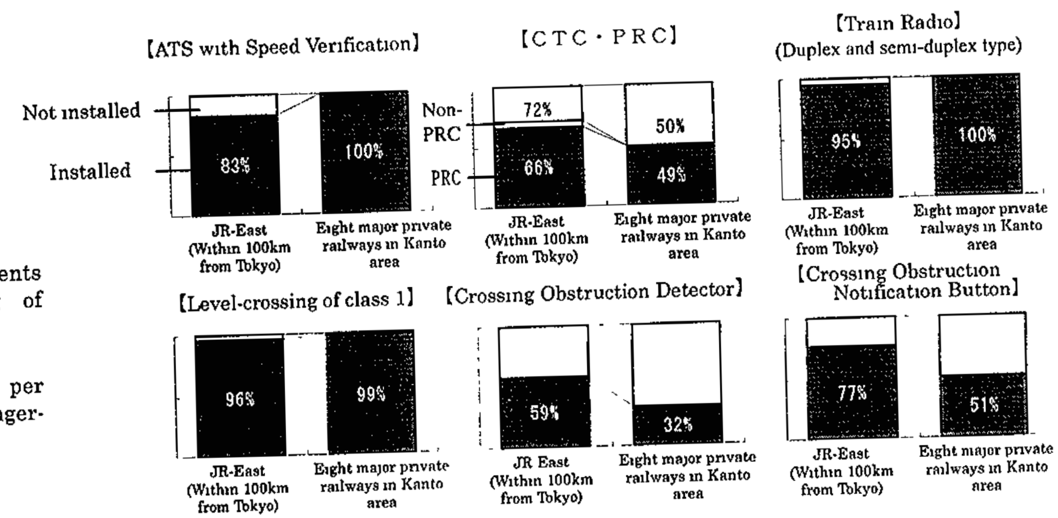
■Preparation of facility management system (EWS etc.) and various kinds of maintenance work devices and equipment

■Preparation of a factory organization that adapts to new technologies

Railway Accidents



Comparison with major private railways in terms of the installation of railway facilities



「Overview of "Safety Plan 21 – Safety Policy for the 21st Century –" 【Separate Sheet 2】

Accidents causing customers' death and injury / Accidents causing employees' death ⇒ Zero

Intensive installation of safety facilities

Measures to prevent serious accidents

Accidents which cause customers' death and injury and employees' death or which are liable for JR East itself ⇒ "Zero"

■**Upgrade of conventional measures (to be completed)**
- Complete installation of train collision prevention measures
  - Completion of ATS-P phase-IV installatio · Installation of a new function of speed verification into the lines with ATS-SN
  - Further installation of an ATS-SN device which prevents wrong departure ,etc.

■**New measures (to be started)**
- Guarantee of safety during maintenance work — Reformation towards separation of train operation and maintenance work —
  - Preventing accidents resulting from mistakes during the procedure to start and to end maintenance work
  - Preventing accidents related to the use of maintenance cars
  - Protecting sections where maintenance work is conducted, by promoting the equipment which short-circuits a track circuit
  - Improving the manuals which describes about the prevention of accidents involving train-hitting of human being
  - Promoting installation of a portable radio receiver (TC-type) which warns train-approaching ,etc.
- Prevention of the mis-operation of train doors — Building a backup system for the wrong opening of doors
- Prevention of the customers' being caught between doors — Building of drastic measures including technological development
- Measures to prevent the excess of train speed in a section where speed is temporarily limited, to prevent unexpected movement of parked cars, and to prevent mis-operation of the lever which operates a level-crossing manually , etc.

■**Measures to prevent accidents concerning the maintenance of rolling stock and infrastructure**
- Prevention of axle breakage, the falling off of rolling stock parts, gauge expansion, non-lowering of crossing gates, wrong signaling, etc

■**Measures to prevent accidents at station platforms and at level-crossings**
- Further installation of train-emergency-stop-warning devices into a platform · Improvement of the ability of a crossing to protect, including thicker crossing gates · Campaigns, etc.

■**Measures to prevent accidents caused by natural disasters**

Raising the level of safety

the prevention of serious accidents, and the accomplishment of the steady train-running with no delay

■**With its social duty and its customers' expectation, JR East improves the level of safety, considering the "safety", especially the prevention of serious accidents, a top priority.**
- Guarantee of safety by executing basic actions and other basic rules

⇩

- Removal of factors that affect transport stability, including serious accidents and mal-function of rolling stock and ground facilities

⇩

- Prevention of accidents caused by human operation during troubles – a period when train operation greatly depends on human ability to pay attention

⇩

- Raising the level of safety (prevention of serious accidents, and the accomplishment of the steady train-running with no delay)

Appropriate response to various kinds of changes

Tasks to respond to various kinds of changes appropriately

■**Reformation of train operation system**

○ Train operation system with no station employee
- ⟹ · Further installation of PRC and CTC · having a large station controlled by a central operation center through CTC · Reviewing various kinds of work and reconstructing them · Technological development, etc.

○ Provision of information for train crews
- ⟹ · Creating a system which provides train crews fixed information (signal positions, etc) and changing information (instruction from an operation center, etc.)

○ Adaptation to the increasingly important role of the dispatcher
- ⟹ · Rearrangement of the dispatcher organization · Upgrade of dispatcher facilities · Improvement of the ability to deal with any troubles ,etc.

■**Training of young employees**

○ Appropriate training and further understanding for each individual ○Education of the social discipline as a member of society

○ Improvement of the support system and communication ○Improvement of education, instruction, and training concerning the basic of safety ,etc.

■**Inheritance of veterans' skill, and response to new technologies**

○ Extraction of the special skill that need to be inherited ○Preparation of an educating and training system in order to teach the basic mechanism of facilities and technologies unique to railways

○ Promotion of computerized equipment and maintenance-free facilities ○A challenge to acquire the certification of ISO 9000 series

○ Establishment of a medium-term plan concerning the safety for cooperating companies , etc.

■**Safety concerning freight trains of JR Freight**

○ Continued demand for the installation of ATS-P and for the measures to improve the safety level, and the cease of entrusting and being entrusted concerning train crews and cars

Rebuilding a safety culture

Creating a safety culture to promote measures for safety in advance

■**Proper understanding of accidents**

○Re-recognition that the "proper understanding of accidents" is the first step to create a measure to prevent re-occurrence of the accidents

○Improvement of the ability to analyze, in order to determine the cause of the accident properly

○Making sure that the stressed determination of the cause doesn't result in a loss of awareness concerning the importance of employees' duties. , etc.

■**Independent safety-seeking activities of each employee ("Challenge Safety" activities, etc.) , and upgrading education and training systems**

○Upgrading education and training systems which deal with basic skills and knowledge of safety

○Execution of basic action properly by each employee ○Creation of new approaches to activate "Challenge Safety" activities , etc.

【Separate Sheet 3】

Future Intensive Measures for the Safety

— Railway accidents which cause customers' death and injury and employees' death / Railway accidents liable for JR East itself } "Zero" —

Upgrade of Conventional Measures
- **Completeness of the measures**

New measures to be started
- **Creation of new measures for the facilities**
- **Review of the measures which hadn't been considered for systematization**

Upgrade of train operation and maintenance work systems

★ : Measures already taken

■ Prevention of train-collision accidents — Complete installation of train collision prevention measures —

★Completion of ATS-P phase-IV installation
・ **Installation of a new function of speed verification into the lines with ATS-SN**
・ Further installation of an ATS-SN device which prevents wrong departure
★Measures to prevent train drivers from driving with the ATS-switch turned-off

■Guarantee of safety during maintenance work —Reformation toward separation of train operation and maintenance work—

○**Prevention of accidents resulting from mistakes during the procedure to start and to end maintenance work**
★Further installation of the maintenance work management system of ATOS
・ Development and installation of the "maintenance work management system" (for major lines which ATOS system haven't been installed) and the "supporting system for the procedure to reserve an area for maintenance work" (for local lines)
○**Prevention of mistakes related to the use of maintenance cars**
★Study of realization that, like other train cars, large maintenance cars run short-cutting of track circuits
・ Preparation of "ATS for maintenance car " (into ATOS sections, etc.)
○**Protection of maintenance work sections, etc.**
・ Promotion of the use of the device which short-cuts track circuits
★Installation of the train protection device into backhoes
○**Prevention of accidents involving train-hitting of human being**
★Improvement of "the manual for the prevention of accidents involving train-hitting of human being" for all divisions including Marketing and Transport & Rolling Stock divisions
★Promotion of a portable radio receiver which warns train-approaching

■Prevention of mis-operation of train doors — Creation of a backup system for the mis-operation —

・ **Start of installation of the facility, which confirms that train is stopping within a designated section at a platform to prevent mis-operating of train doors, into major lines in the Tokyo metropolitan area**

■Prevention of the customers' being caught between doors —Creation of drastic measures including technological development—

★Replacement of old train cars with new ones (rolling stocks, such as Series 209 and 217, with devices that detect objects caught between doors)
・ Development and installation of low-cost safety devices to detect objects caught between doors

■Prevention of the excess of train speed in a section where speed is temporarily limited

・ Study of the systematization of work related to train-running with limited speed (discussions, notifications, signal confirmations, etc.)
・ Execution of the test for the improvement of visibility concerning the shape and the color of temporary signals
・ Study and installation of a backup system using ATS transponders for the confirmation of signal indication

■-Prevention of unexpected movement of parked cars.
-Prevention of mis-operation of the lever which operates a level-crossing manually
—Study of future train operation at a station—

・ Study of limited measures, including the elimination of some work, in the situation that the uncontrolled movement of cars occurs only in a area with downward gradient.
・ Study of a system which deals with operation of the lever which operates a level-crossing manually and with other works simultaneously, because the lever for manual operating of a level-crossing is operated during manual signaling and shunting work, which may make operators confused.
・ Promotion of the discussion results from the "study committee on the vision of train operation at stations in the future"

Maintenance

Measures related to the maintenance of rolling stock and infrastructure (including Shinkansen)

◆Axle breakage and the falling off of rolling stock parts
◆Gauge expansion
◆wrong signaling
◆Non-lowering of crossing gates

⇒

☐Emphasis on the management system for safety by improving the management of data concerning maintenance in each division (including Shinkansen) and by reviewing manuals on safety, etc.
☐Preparation of organized structure to multi-check the facilities in many aspects and to handle troubles immediately and appropriately, when new systems and technologies are installed
☐Development of various kinds of sensors, simulators, etc, and the promotion of computerized crossing controller and H-type train detector for level-crossings

Related to the human factors of customers and the public

Measures related to the human factors of "customers" and the "public"

At Platforms

At Level-Crossings

◆Measures to prevent customers from contacting trains and falling at platforms
◆Measures to prevent accidents at level-crossings

⇒

☐Steady promotion of measures to prevent accidents at station platforms
・Promotion of conventional measures to prevent customers from contacting trains and falling at platforms, and the study of the measures to protect customers on a platform more effectively, such as the installation of a fence into a platform
☐**Further improvement of the ability of crossings to protect**
・Further installation of the detectors which detect obstruction at a level-crossing into the Tokyo metropolitan area.
・Further installation of thicker crossing gates, and the installation of European crossing gates
・Promotion of the way to watch for illegal crossers with monitoring cameras and to report them to the police
☐**Promotion of campaigns through a year, etc.**
・Promotion of campains concerning platforms and level-crossings to acquire the understanding and the cooperation of its customers and the public

Measures against natural disasters

Measures against natural disasters

◆Promotion of measures to prevent accidents caused by natural disasters

⇒

☐Improvement of the prediction and detection technique
・Acquisition of information on the exact amount of rainfall (and the review of regulated values)
・Analysis of wash & delve and rock slide phenomena
・Development of detection systems , etc.
☐Promotion of extra preventative measures for important lines
・Intensive promotion for the Chuo line and other major lines in the Tokyo metropolitan area

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Bill Casley

Overview of safety Considerations for the construction and operation of Australia's First Very High Speed Railway: Sydney to Canberra

Publisher
2000 International Rail Safety Conference

BIOGRAPHY

William Sydney Casley

Bill is a professional engineer whose career in public service has spanned some 47 years within the Australian Railway Industry His career has involved some 40 years with the NSW Government Railways, commencing as an Apprentice Rail Car Builder and progressing through a number of senior executive positions, including Works Manager, Chief Production Manager, Assistant General Manager Workshops and Chief Mechanical Engineer. This was followed by some 7 years with the NSW Department of Transport as Executive Director of the Department's Railway and Transport Safety Divisions.

Over the 7 years prior to his retirement from the Department, Bill has been at the forefront in the establishment of Rail Safety Legislation and rail safety regulatory practices within Australia

Bill's extensive knowledge and depth of experience in the Rail Industry led in 1992 to him being seconded from State Rail to the Department of Transport to the comprehensive role of formulating and establishing major new legislation to ensure that all railways within NSW were operated safely This new legislation, the NSW Rail Safety Act 1993, established a significant landmark in the operation of railways in NSW and has served as a national benchmark for similar legislation in every other jurisdiction in Australia

In February 1999, Bill established Bill Casley Consultants Pty Ltd, with the aim of providing a service to the rail industry in relation to rail safety. A principal client of the company has been the Speedrail Group Pty Ltd in relation to its proposal to construct and operate Australia's first very fast train between Sydney and Canberra Amongst the tasks associated with this group has been the establishment a suite of railway safety principles for the proposed high-speed railway and the development of Speedrail's Safety Management Plan. This plan is aimed at identifying the significant safety risks associated with the proposed railway together with specifying the action Speedrail will employ to address these risks.

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INTERNATIONAL RAILWAY SAFETY CONFERENCE
BANFF, CANADA – OCTOBER 1999

OVERVIEW OF SAFETY CONSIDERATIONS

FOR

THE CONSTRUCTION AND OPERATION

OF AUSTRALIA'S FIRST VERY HIGH SPEED RAILWAY

SYDNEY TO CANBERRA

Sydney-Canberra
SPEEDRAIL

Paper for presentation at the Tenth International Rail Safety Conference,
Banff, CANADA
19–22 October 1999

OVERVIEW OF SAFETY CONSIDERATIONS

FOR THE CONSTRUCTION AND OPERATION

OF THE HIGH SPEED LINE

SYDNEY TO CANBERRA

ABSTRACT

The Australian Commonwealth Government announced in August 1998 the selection of the "Speedrail Group" as the preferred proponent to construct and operate Australia's first very high-speed railway. The railway will operate over a distance of some 270 kilometres between Sydney and Canberra. The Speedrail timetable will be based upon a 45 minute interval service. Services will operate from 0600 to midnight, 7 days a week, 365 days per year. The service will comprise 48 trains a day (24 each way), with an average interval of 45 minutes. The journey time for express trains between Sydney and Canberra will be less than 85 minutes.

The new service is scheduled to commence in 2005. The railway consists of two distinct parts, one part consisting of infrastructure shared with other railway operators in the Sydney suburban network (52km) and the remainder being new high speed infrastructure (designed for operating speeds of up to 350 km/h) from the edge of Sydney to Canberra.

The initial operating speeds on the line will be up to a maximum of 160 km/h in the Sydney suburban network and up to 320 km/h on the new infrastructure.

The purpose of this paper is to highlight a range of safety considerations that have been taken into account as part of Speedrail's process to develop a safety management plan for inclusion in its application for accreditation, for the high speed railway, under the New South Wales Rail Safety Act.

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Sydney-Canberra
SPEEDRAIL

Contents

SAFETY CONSIDERATIONS

FOR THE CONSTRUCTION AND OPERATION OF THE HIGH SPEED LINE

SYDNEY TO CANBERRA

1. INTRODUCTION

The Australian Commonwealth Government announced in August 1998 the selection of the Speedrail Group Pty Ltd (Speedrail) as the preferred proponent to construct and operate Australia's first very high-speed railway.

The purpose of this paper is to highlight a range of safety considerations that have been taken into account as part of Speedrail's process to develop a safety management plan for inclusion in its application for accreditation, for the high speed railway, under the New South Wales Rail Safety Act.

In developing its safety considerations Speedrail recognises its responsibility to comply with regulatory safety requirements.

The paper is set out to give the reader a general overview of the safety considerations and some of the outcomes Speedrail will employ to ensure the safe construction, maintenance and operation of its high speed railway. In this regard the paper is set out in sections which reflect areas for safety consideration. Within each section is a short description of the outcomes Speedrail intends to apply to address the issue.

It should be noted the paper's contents are not intended to be an exhaustive list of safety considerations nor do they appear in the paper in any precise order of priority. The intent is to provide an overview of the progress achieved to date in addressing the safety issues involved in Speedrail's high speed railway.

The Speedrail project is aimed at providing a high speed rail service between Sydney and Canberra, to be operated over a distance of some 270 kilometres and serving centres along its route.

The railway will consist of two distinct parts:

(i) **Sydney Entry,** consisting generally of Rail Access Corporation's (RAC) infrastructure shared with other railway operators in the Sydney suburban network (50 kms), and

(ii) **The High Speed Line (HSL)** being a new high speed infrastructure (designed for operating speeds of up to 350 km/h) from the edge of Sydney (Macarthur) to Canberra (220kms).

A commercially viable rail service, in successful competition with other transport modes in the corridor, requires the shortest possible journey times. This will be provided by TGV trains.

The TGV has an outstanding record of commercial service, with routine operations in several countries at 300 km/h. Since 1981 over 500 million passengers have been carried safely more than 1 billion kilometres.

TGV technology has room for growth, with a 350 km/h train currently under development. A TGV has achieved a speed on trials of 515 km/h including multiple runs above 400 km/h.

To achieve the necessary journey times utilising TGV trains, a new rail infrastructure must be provided from Canberra to the edge of Sydney. The existing railway between Sydney and Canberra has a very poor alignment and it is not economically feasible to upgrade it for a commercially viable high speed passenger service.

Within the Sydney suburban network, the trains will use existing tracks, or additional track laid within an existing route corridor. Speedrail's trains are fully compatible with the RAC's track, electrical supply and signalling systems of the Sydney suburban network, having dual power and signalling systems.

The initial rolling stock for Speedrail's high speed railway has been designed to operate at the maximum permissible speed in the Sydney suburban network (160 km/h) and up to 320 km/h on dedicated infrastructure from the edge of Sydney to Canberra.

Speedrail's civil infrastructure will be built to accommodate 350 km/h trains.

2. KEY FEATURES OF THE PROPOSED HIGH SPEED SERVICE

The journey time from Sydney Terminal to Canberra for express trains will be less than 1 hour and 25 minutes. This journey time is comparable with air when access/egress, check-in and waiting times are taken into account. The service will be frequent, with a trip every 45 minutes from 0600 until midnight.

In the Sydney Entry area, Speedrail trains will run at the maximum permissible speed allowed by the infrastructure of the suburban network.

Speedrail's Sydney Terminal will be at Central Station. Services will travel via the New Southern Railway, due for completion May 2000, and will be able to pick up passengers to and from Canberra at the domestic and international terminals at Sydney airport. The Canberra terminal will be located at Canberra Airport, which will become the major transport hub for Canberra and the surrounding region.

On the HSL, two intermediate stations will be provided, one in the Southern Highlands District and one serving Goulburn (a major rural centre).

The initial service frequency can be accommodated with the new high speed line built substantially as a single track.

The easement will allow for any later enhancement of the line required to meet growth in traffic.

The HSL will have no level crossings. The right-of-way will be fenced, with overpasses and underpasses to provide access across the line for vehicles, people and animals.

On the HSL, platforms at intermediate stations will be placed alongside loop lines, allowing non-stopping trains to overtake trains stopped in the platforms, via the main line.

An advanced automatic train control system, integral with in-cab signalling, will be provided on the HSL, similar to that currently used by TGVs in Europe.

3. NSW RAIL SAFETY ACT

The New South Wales Rail Safety Act was proclaimed on the 21 September 1993 with the object to promote the safe construction, operation and maintenance of railways within New South Wales.

The Act applies to all railways operating in NSW with a track gauge of 600mm or more and the owner of any railway infrastructure and the operator of any rolling stock within the state must be accredited under the Act for these purposes.

The Act does not lay down prescriptive or universally applicable safety standards for an accreditation under this Act. Rather the Act provides that the primary emphasis is to be on the development and enforcement of railway safety standards proposed by the owners and operators and examined and agreed by the regulating authority (in NSW, the Transport Safety Bureau).

This approach is designed to ensure safety standards and practices will match the need for each individual railway.

A railway owner or operator seeking an accreditation is required to submit to the regulator an application which details how the proposed railway is to function safely. In this regard, among the information to be provided is an identification of the significant safety risks associated with the proposal; the proposed safety standards; systems and management plans; information regarding management and financial capabilities; the infrastructure; rolling stock and other equipment to be used; staffing; and organisational structures.

In particular the application is to contain a comprehensive safety management plan that identifies the significant potential safety risks associated with the proposed railway and specifies the systems, audits, expertise and resources the applicant will employ to address these risks. In this regard Speedrail is currently developing its safety management plan. This development is utilising the safety considerations contained in this paper and Speedrail's document *Railway Safety Principles*.

Speedrail's document *Railway Safety Principles* will be one of a suite of documents which will set out the relevant principles, codes of practice and/or standards that have been accepted in relation to Speedrail's accreditation, under the NSW Rail Safety Act.

4. AUSTRALIAN STANDARD AS4292: Railway safety management

This standard was prepared to establish a uniform set of safety standards to simplify the development of railway safety management systems in Australia and to facilitate the safety accreditation of railway industry participants throughout the nation. Accordingly AS4292 aims to ensure that railways take appropriate action to limit the risk of injury to persons or damage to property, to acceptable levels.

Whilst AS4292 was prepared prior to the decision for the Speedrail project to proceed, its general principles are still relevant. Consequently, the development of Speedrail's safety management plan will be undertaken with due cognition of the safety standards described in AS4292.

5. MANAGEMENT POLICY AND STRUCTURE

Speedrail recognises that positive measures will be required to develop a culture in which safety has appropriate emphasis. Accordingly Speedrail is developing a suite of documents that will describe its relevant policies, principles, standards, codes of practice and procedures that will be applied across the organisation to ensure the objective of safely constructing, maintaining and operating the high speed railway is achieved.

Speedrail will put in place systems to ensure staff engaged in activities affecting railway safety have:

- The physical and mental fitness to do the work
- An adequate sense of responsibility to be entrusted to do the work
- The necessary capacity including communication and technical skills, and knowledge to perform the work.

Senior management will review safety performance regularly.

The management review will:

- confirm by safety audits that the requirements of Speedrail's safety documentation are being correctly followed
- the effectiveness of the safety documentation
- consider and where necessary act upon reports of action programs implemented to deal with specific situations
- review progress in achieving targets for hazard or risk reduction
- review investigations into hazardous incidents
- review the record of frequency of occurrence of hazardous incidents
- consider the effectiveness and adequacy of safety systems in general.

The proposed management structure for Speedrail is shown in Appendix 3.

The Safety Manager is the nominated manager responsible for ensuring the continuing compliance with Speedrail's safety documentation and their continuing effectiveness through a safety audit system.

The safety responsibilities of staff, sub-contractors and others identified as having railway safety responsibilities will be documented.

6. HAZARD INDENTIFICATION

Speedrail recognises that in its operation of the HSL situations may arise where undesired or unexpected outcomes could impact significantly on the safety of its railway. A risk management process has been established to analyse and evaluate the risks as a precursor to establishing relevant reduction/control mechanisms.

Initially a qualitative approach will be used to identify significant potential risks on the HSL. In this regard a hazard identification workshop was conducted involving a range of stakeholders influenced by the project. Participants included representatives from:

- Speedrail Group
- Rail Access Corporation
- State Rail Authority
- Maintenance Contractors
- Qantas Airways
- Australian Capital Territory Agencies including emergency services
- NSW Agencies including transport safety and emergency services

The findings of this initial workshop identified some 193 risks spread over a wide spectrum of original and residual risk situations.

The top five risks were perceived as:

- Suicides
- Negligence of staff to carry out procedures
- Trespassers taking short-cuts across high speed line
- Passenger trip/fall on platform

- Staff lack of skill - unsafe practices

Speedrail recognises that further studies will be necessary to formally identify the risk profile of the HSL. Amongst these studies will be a principle task of establishing provisions for dealing with original risks such as collisions and derailments, etc.

It is considered the existing TGV provisions established for operations in Europe are an appropriate benchmark upon which to base Speedrail's actions.

7. RAILWAY SAFETY PRINCIPLES

An important aspect of the Speedrail Group's safety policy is a recognition of the need to establish appropriate railway safety principles by which the construction, maintenance and operation of the high speed railway is to be achieved. In this regard Speedrail has established a document *Railway Safety Principles* to achieve this aim.

Speedrail's *Railway Safety Principles* are intended to give advice, by clearly defining the railway safety principles that Speedrail will established as minimum safety standards for the design, construction, maintenance and operation of the High Speed Line, Sydney to Canberra.

Railway Safety Principles as a document covers the types of operational systems, infrastructure or rolling stock that Speedrail will use in its activities. It should be noted the principles apply to the finished infrastructure or rolling stock but not to the processes of designing or building such assets.

Regarding operations on the Sydney Entry sector, Speedrail's relevant accreditation for this sector will be predicated on a satisfactory demonstration that as an accredited operator it will achieve compliance with the relevant sections of the accreditation previously granted by the Department of Transport to the Rail Access Corporation. In this regard it is envisaged that there will be no conflict between the principles contained in Speedrail's document *Railway Safety Principles* and any requirements attached to Speedrail's accreditation as an operator on the Sydney Entry sector.

8. LEVEL OF SAFETY TO BE ACHIEVED

Due consideration has been given to implementing the railway safety principles in a way that ensures that all intolerable risks have been eliminated and that all remaining risks have been reduced to be as low as reasonably practicable. In this regard Speedrail intends to achieve a level of safety for its activities that is at least as good as existing established high speed rail systems with proven performance.

In addition to considering the risks that may arise during the various operating conditions of the railway, Speedrail has also taken into consideration the risks that may arise from outside, as well as from within its railway system.

9. EMERGENCY SITUATIONS

Speedrail's emergency procedures plan will consider both life threatening and non-life threatening situations.

The emergency plan will delineate the responsibilities assigned to responding personnel for the supervision, correction, or alleviation of the emergency.

The following types of emergency will be considered as requiring the invoking of a relevant emergency procedure plan:

- First aid or medical attention required by passengers.

- First aid or medical attention required by Speedrail staff or contractors working on the Speedrail system.
- Disabled or stalled trains under adverse conditions.
- Evacuation of passengers from a train under adverse conditions
- Collision or derailment of rolling stock.
- Vandalism affecting the safety and security of the railway.
- Fire or a smoke condition on a train.
- Fire or a smoke condition on any part of the Speedrail system
- Fire or smoke condition adjoining or adjacent to the Speedrail system that threatens the system or disrupts service.
- Serious flooding of the system.
- Loss of electric traction infrastructure resulting in a stalled train(s)
- Structural collapse or imminent collapse of the infrastructure that threatens the system.
- Any discharge of flammable, toxic or irritating materials into the Speedrail system that threatens people or the system.
- Extreme weather conditions causing disruption of services.
- Natural disasters which threaten the system or disrupt services.

Speedrail staff will be trained to enable them to be conversant with relevant aspects of the emergency plan to enable them to function efficiently in an emergency.

If an incident occurs that affects or is likely to affect the normal operation of the HSL, it will be the responsibility of Speedrail staff with knowledge of the incident to inform the Operations Superintendent at the OCC.

10. SECURITY

It is Speedrail's goal to achieve the highest practical level of security for all aspects of its operations.

Speedrail recognises that the profile of this new high speed railway may make it vulnerable to a range of anti-social behaviour likely to be centred around acts of trespassing.

In this regard Speedrail will develop a security program aimed at establishing effective security measures to reduce the potential for crime and improve passenger security.

Speedrail recognises that the development of the HSL provides an ideal situation whereby the design of its infrastructure can reduce opportunities for criminal behaviour and reduce fears for the passenger.

11. COMPETENCY OF STAFF

Speedrail will establish a program to ensure all staff are adequately trained and qualified to competently safely perform their respective duties.

An appropriate monitoring process will be established to ensure an adequate assessment of competence is maintained amongst its staff engaged in railway safety work.

Appropriate competency records will be maintained

12. COMMUNICATION - STAFF

Speedrail will institute a document control system to ensure relevant staff are able to receive appropriate and current documents and data. Changes to documents and data will be identified and recorded.

A follow-up mechanism will also be instituted to establish that staff understand the instructions which are relevant to their function. Where deficiencies are uncovered relating to individual staff, appropriate remedial action will be instituted without delay.

13 MEDICAL STANDARDS

Speedrail will establish medical fitness standards for staff involved in the construction, maintenance and operation of its HSL.

Relevant confidential records will be maintained of the staff's health and fitness.

14. DRUGS AND ALCOHOL

Speedrail will establish a firm policy regarding a "no-use policy" of these and similar substances by its own staff and the staff of any contractor required to carry out safety critical work on behalf of Speedrail.

It will be a condition of employment for Speedrail staff to voluntarily agree to undertake random tests for drugs and/or alcohol when called upon in terms of the policy.

15. CONTRACT MANAGEMENT

Speedrail has contracted with Leighton Alstom Construction Consortium (LACC) to procure the design and construction of the high speed line and the supply of rolling stock.

Speedrail will require LACC to warrant to it that the design, construction and supply of infrastructure, equipment and trains will be fit to allow operation of the high speed rail service at the designated performance levels.

SNCF/SYSTRA (French Railways) has been engaged as an overview consultant to provide high level design overview advice to ensure that technical proposals comply with the performance specifications. SYSTRA has substantial expertise in this regard from its involvement in the design of very high speed rail systems in Europe and elsewhere.

16. PURCHASING

Speedrail's management system will incorporate the relevant system elements of AS/NZS ISO 9001:1994, "Quality Systems…".

Purchasing procedures will be adopted to ensure, amongst other things, that railway safety requirements are clearly communicated to subcontractors and taken into account in the evaluation and selection of subcontractors.

These procedures will include maintaining records of subcontractors in relation to, amongst other things, railway safety requirements and railway safety performance appraisals.

17. INFRASTRUCTURE

The HSL is designed in accordance with proven International Standards which call for higher standards than those normally applied for passenger services in Australia.

This requirement is borne out of the stringent geometric and dynamic performance criteria necessary for the operation of Speedrail's high speed railway.

Maintenance of the infrastructure will be carried out in accordance with proven maintenance policies and practices that have served the existing

European TGV operations successfully since 1981.

A diagram of the route of the HSL is attached as Appendix 1.

18. THE TRACK

The track proposed for the HSL is designed utilising existing proven TGV technology.

The following criteria has been applied to the design of the track of the HSL:

- minimum radius of curvature for alignment:
  desirable value – 6250m radii
  limiting value – 5556m radii
- track centres for main line double tracks - 4.3m
- maximum gradients used in the design of the alignment:
  desirable value – 2.5%
  limiting value – 3.5%
  exceptional value – 3.7%
- vertical curves:
  recommended – 25,000m
  standard minimum – 21,000m
  exceptional – 19,000m.
- turnouts for normal use on the HSL are based on relevant UIC codes and are limited to 3 designs:
  type tg - 1/65 (Speed rating 230 km/h)
  type tg - 1/21 (Speed rating 100 km/h)
  type tg – 1/15 (Speed rating 80 km/h)
- station tracks will be on straight track throughout their length, with a maximum gradient of 0.15%.
- yard and depot tracks for stabling and maintenance the high speed train sets will be designed on the basis of minimum radius of 250m and a minimum distance between track centres of 3.8m.

A typical cross section of the track is shown in Appendix 4.

19. UNWANTED INTRUSION AND UNAUTHORISED ACCESS

The entire route will be closed to public access by means of fences.

Overpasses and underpasses will provide access across the line for vehicles, people and animals.

There will be intrusion detectors to control any access to lineside signalling equipment technical rooms and the power supply substations.

No access will be permitted to the critical safety zone along the alignment when the services are in full operation, unless such access complies with approved authorisation protocols.

A single multi-functional operation control centre (OCC) is to be provided. Amongst its functions will be the requirement that it monitor intruders and take appropriate action to deal with these intruders.

Earthworks have been designed to minimise the effect of rock and mudslides. In areas of potential subsidence due to underground coal mining, detectors linked to the OCC will be provided.

Detectors will be provided near and on over-bridges to detect vehicle intrusions on the line.

Appropriate lineside access roads will be provided for the maintenance of the HSL and its equipment. Controlled access gates will be provided at strategic locations to enable maintenance and emergency staff to gain access to the safety zone. In these situations, access will be controlled by the OCC Supervisor, utilising established protocols.

20. CLEARANCES

All wayside equipment and structures will comply with the infrastructure clearance gauge. The positioning of Electric Traction Infrastructure equipment is in accordance with European Standard EN- 50122

Wherever practical, line side equipment will be located such that normal maintenance can be carried out without the need for additional measures to protect personnel or disturb train normal services.

Should a train be stopped on the HSL and it is necessary to evacuate passengers, provision has been made for egress by the train's external doors to be controlled. The locking control permits either the right or left hand side of the train doors to be unlocked so that passengers disembark on the safe side of the train.

On the HSL the requirements of UIC gauge standard UIC 505 will be applied.

On the Sydney Entry, Speedrail's kinematic envelope at all times is less than that which applies to RAC's maximum wide electric rolling stock gauge. Consequently, Speedrail's rolling stock will be compatible with RAC's requirements.

21. INFRASTRUCTURE LOCATION IDENTIFICATION

An identification system is to be implemented whereby all structures and facilities on the HSL will be readily identifiable for location purposes. This is essential to ensure correct identification of a location, particularly in emergency situations.

22. EARTHWORKS AND STRUCTURES

The design for railway bridges on the HSL is in conformity with UIC code 776-2R.

The design for overbridges on the HSL is in conformity with NSW and ACT Government standards for road overbridge structures.
There are two locations on the HSL where it will be appropriate to place the HSL alignment in tunnel. These tunnels will have a minimum cross-sectional area of 75 square metres to ensure aerodynamic stability and passenger comfort under operational speeds.

On the Sydney Entry there will be one location where tunnelling will be provided as part of the system to provide Speedrail with suitable access to the suburban network. These facilities will conform to the RAC's standards for tunnels.

Diagrams of typical structures are attached as Appendix 5

23. MINE SUBSIDENCE

The HSL traverses the Southern NSW coal deposits over some 80 kms of the corridor between Campbelltown and Berrima.

The depth of these coal deposits varies between approximately 700 metres at the Campbelltown end to approximately 100 metres at Berrima

Speedrail recognises the necessity to develop a strategy to address the risk of mine subsidence impacting operations on the HSL.

The primary objective of its strategy to ensure that Speedrail can operate the system at a safe, continuous level of high-speed service with potential interruptions caused by mining subsidence being limited as follows:

- Minimisation of occurrences of mine subsidence.
- Speed restrictions.
- Remediation works.

The strategy to achieve this comprises six main streams:

- **a mining regime**, which provides predictions of likely times coal reserves may be extracted.
- **route selection,** adjustments to minimise the length of the alignment exposed to mining activities.
- **movement**, the object of this stream is to be able to determine with confidence, in advance, when movements will occur which require the imposition of speed restrictions and remedial action to the HSL.
- **design**, this stream will provide solutions for the civil infrastructure, which can accommodate the movements, which may occur.
- **remediation**, this stream will ensure that remediation back to the in-tolerance configuration will be carried out both expeditiously and in a timely manner. Key elements will be the provision of detection devices and the positioning of rapid response maintenance equipment adjacent to potential movement sites.
- **expert opinion** from the coal industry will be used by Speedrail to address the areas of mining regime, predicted movements, design, and remediation.

24. STRUCTURAL INTEGRITY OF TRAINS

The car-body structure and bogies are designed to withstand train loads under normal operation.

The cars are designed with a proven crashworthiness, with high compressive strengths in areas occupied by passengers and crew.

The power car at each end of the train provides protection against both front and rear end collisions.

The articulated design of the train with coaches sharing bogies has been proven to maintain the integrity of the rake in the event of a derailment.

A typical diagram of TGV vehicles is attached as Appendix 2.

25. TRAIN INTERIORS

Windows are designed according to UIC standards. There are four emergency exit windows per trailer.

Safety labels, warning and pictograms are provided to indicate to passengers the emergency devices.

The trains will carry emergency and protection equipment such as: first aid equipment, megaphones, portable lights and two ladders, one at each end of the train.

The power supply of lighting is backed up by batteries. These batteries provide for around 90 minutes of emergency lighting, fitted in each passenger car.

Sharp edges and corners and points are avoided in the train interior.

Coolants used in electrical equipment are of low toxicity, low flammability and provide for a safe environment.

26. FIRE PREVENTION ON TRAINS

Speedrail's TGV trains are compliant with the Fire and Smoke Standard for French high speed lines.

Speedrail will enforce a "no smoking" policy for all passengers.

Over-temperature sensors are provided in the electrical traction equipment cases of the power cars.

Hand-held fire extinguishing equipment will be provided in each power car cab.

Reactions to fire, toxic and opacity fumes emitted during combustion of the materials has been taken into account. The materials used are selected in compliance with the standard NFF16101 and will be applied as previously applied on existing TGVs.

Fire alarms are reported to the Driver's cab with audible and visual information to the driver. The location of the fire is displayed on the on board computer.

Overheating sensors are installed in the zones of the train set in which fire is most likely to occur. These are: power battery chargers in trailers, electrical power cabinets, inverters in trailers, battery chargers in trailers, the motor blocks, the auxiliary block and the main transformer in the power-cars.

Detection of fire in a power car will lead to the following actions. The ventilation will be stopped and the power circuit isolated in the affected area, and the main circuit-breaker is opened.

Each passenger car is fitted with portable fire fighting equipment.

Doors and walls are designed to limit the spread of smoke.

27. TRAINS – ACCESS/EGRESS

External doors are of sliding plug design and have door closing interlocks. The doors will be fitted with an obstacle detection system to alert the conductor if any door is not properly closed. The doors cannot be opened by the passengers during a journey, except for emergency evacuation.

Should the train become stopped on the main line and it is necessary to evacuate passengers by disembarking from the train, the locking control of the doors is individual for the right and the left side of the train in order to make sure that passengers disembark on the safe side of the train.

Each passenger car is fitted with means of emergency egress either via the doors (in the event of a door mechanism failure) or selected windows if the doors cannot be used.

28. TRAIN COMMUNICATIONS

The train is equipped with backup batteries to provide power to the vital equipment in case of failure of the high voltage equipment. Vital equipment consists of:

- Train to ground radio
- Communication system train master/ driver
- On-board public address
- Emergency lighting.

The communication system includes a radio between the operating power-car and the OCC.

Each passenger car is fitted with appropriate communications systems to enable the train driver and the on-board crew to control incidents and direct activities or any required evacuation.

The communication system includes intercoms to enable the crew members to communicate with each other in the train.

The communication system also includes a public address system which enables the crew to communicate with the passengers.

A passenger alarm will be provided. Each trailer has two alarm signal handles, located at each end of the passenger compartments. Passengers can also use the talk-back modules of the passenger-Train Master intercoms. The alarm is transmitted to the driver's cab so that the crew, Train Master and the driver can initiate appropriate action.

29. SPEED REGULATION

The emergency brake command incorporates fail-safe functions. The mechanical brake complies with UIC standards.

The trainsets are equipped with parking brakes to prevent them from unintended moves, when parked. The brake force complies with UIC standard.

The main train brake pipe cannot be easily and involuntary disconnected by passengers.

The emergency brake system is designed to ensure safe operation at all speeds up to the maximum operating speed under all Speedrail alignment gradient and for the adhesion conditions.

The trains will be fitted with in-cab signalling and ATP equipment, a proven braking system and a train driver's vigilance device.

The braking system does not incorporate components which could be harmful or emit poisonous substance.

The tachometry provided on the TGV trains is of a proven design.

30. TRAINS – RUNNING GEAR

Bogies are of a proven design. They are equipped with instability sensors. Detection of instability between rail and bogie is transmitted as an audible and visible alarm into the driver's cab. They are designed to ensure safe operation when there is an air leakage in the suspension.

The wheel/rail interface of Speedrail's rolling stock is compatible with RAC's requirements on the Sydney Entry.

Should the secondary suspension become deflated an alarm is reported to the train driver to enable an appropriate speed reduction to be applied.

31. TRAINS – COMPATIBILITY WITH SIGNALLING

An Electro-Magnetic Compatibility control plan will be implemented to ensure that the system operates safely due to external and internal influence of EMI and has no unplanned electromagnetic interference with the environment.

Electrical and electronic equipment include proven safety design protection which prevent overloading and short circuiting and provide insulation to minimise the risk of electrocution.

32. TRAINS - COMPATIBILITY WITH INFRASTRUCTURE

On the Sydney Entry, Speedrail's TGV trains are compatible with RAC's structure gauge (as defined in RAC's document C2100).

On the HSL sector, Speedrail's TGV trains are compatible with the UIC high speed train structure gauge.

33. TRAINS – COMPATIBILITY WITH ELECTRIC TRACTION INFRASTRUCTURE

The trains are compatible with the electric traction infrastructure. Refer to section 32 above.

A portable overhead cantenary system earthing rod for emergency use is provided on each train set.

34. RAILWAY CONTROL SYSTEM

The HSL's signalling system is designed for safe operation up to a maximum operational speed of 350 km/h.

The core signalling system is comprised of existing, safe and proven signalling components which are used by the high speed railways in Europe.

It is designed to act according to a fail-safe behaviour (i.e. any failure that may affect safety shall lead the affected equipment to a more restrictive state which ensures safety) which can be obtained by different principles (e.g. majority voting, back-proving, information encoding or intrinsic safety). The core signalling system is capable of real-time receiving and processing the information from the warning and protection systems in order to take adequate action (e.g. trigger automatically the braking system or alarm the OCC).

A multiplexed and encoded data link is provided for transmission of vital interlocking data. The signalling system architecture includes an Automatic Train Control System (ATC) which is currently successfully employed extensively in Europe. This fail-safe system provides for safe speed control and train stopping distance control.

The ATC automatically controls the speed of the train to avoid over-speed, over-running of signals and prevent train collisions. It includes the ATP to prevent driver made accidents by over-speed or over-running of signals. The driver may be authorized to run on sight to a maximum speed of 30 km/h.

The ATP is positively interfaced with the braking system of the trainsets. In-cab signalling provides independence from poor weather conditions or reduced visibility on the main line of the HSL.

The signalling system provides a turn back capability on the main line. In this case, the driver must move to the rear power-car and initialize it as the leading power car. The driver may then, when authorised, run "on-sight" until the next marker.
Safety critical items or functions will be continuously monitored. Any train control command from the OCC is processed through the safety check of the interlocking system which will not allow conflicting routes to be set. Warning and protection systems transmit an alarm to OCC or automatically request ATP to activate the emergency braking system.

The signalling system architecture includes Solid State Interlocking (SSI). The SSI system carries out the fail-safe processing and control of the various fixed systems on the route (for example, point machines and lineside signals).

The signalling system architecture includes Train Location facility. The train detection will be accomplished by a system based on track circuits on the main line.

Wayside hot box detectors are provided at approximately every 30 kms along the line to monitor any extreme temperature changes in the axle boxes of each train during its journey on the high speed line. These wayside hot box detectors are connected with the OCC. In case of a detection of a hot box, a visible and audible alarm is transmitted to the OCC.

Anemometers will be provided in critical areas along the route to detect side wind speeds. Appropriate alarms will enable the OCC to take corrective action.

Workers' protection devices will be installed at strategic locations. When activated they protect the affected track from a train entrance or by applying a speed restriction.

35. OPERATING CONDITIONS

In its choice and design of the operational systems; construction and/or maintenance standards; procedures for infrastructure and/or rolling stock, Speedrail not only depends on the safety principles expressed in its document *Railway Safety Principles*, but also on the operational requirements of the railway for which Speedrail holds an accreditation.

This has meant that in assessing the suitability of any proposed safety measures or arrangements Speedrail has taken into account:

(i) normal operating conditions, including the aerodynamic effect of the train;
(ii) degraded conditions where any component or part of the railway system has failed;
(iii) foreseeable abnormal conditions to which the railway system may be subjected;
(iv) emergency situations;
(v) interfaces with other railway owners, operators and utility services; and
(vi) foreseeable environmental conditions to which the operational systems, infrastructure or rolling stock may be subjected. This includes temperature extremes, wind, rain, hail, snow, ice, flood, reduced visibility, land subsidence, earthquake, etc.

36. SAFEWORKING SYSTEM ON THE HIGH SPEED LINE

Safeworking systems play an important role in maintaining the safety and integrity of a railway system. The safeworking system is designed to ensure staff are provided with appropriate instruction to enable them to safely and efficiently carry out the relevant duties of their position.

Speedrail will develop and maintain an effective safeworking system for operations upon its HSL. In general the safeworking system will provide instruction regarding the policies and basis of the system, station management, signalling, train working, engineering work, emergencies and special working associated with the HSL.

37. OPERATIONAL CONTROL CENTRE

A single multi-functional operation control centre will be provided. The operation control centre will control all train movements over the high speed line and monitor the power supply, intruder and fire alarms (in signalling technical rooms and power supply substations), anemometer sensors, CCTV from stations, train radio and trespasser reports. This control centre will therefore house the functions of Central Traffic Control, Traction Power

Control and Major Incident Control Centre.

Direct telephone lines (with voice recording and monitoring functions) are provided in the OCC for supervision, operation, emergency management and disaster prevention purposes. The following functions shall be provided:

- connection to operation telephone (traffic control)
- connection to maintenance telephones (wayside equipment and equipment rooms);
- connection to emergency telephones (wayside and platforms);
- connection to radio system.

Power supply to signalling and communication equipment used for the safe operation of the railway is designed to mitigate the effects of a single loss of the feed AC supply.

The vital control system's power supply will be provided with alternative sources of supply.

Any vital train control command from the OCC passes through the solid state interlocking.

The OCC is not a vital system. Safe speed control and train stopping distance control to protect trains against over-speed derailment or train collision is enforced by the Track Circuits, the Solid State Interlocking and the Automatic Train Control.

The primary role of the OCC is in traffic management. It plays an important role in the management of emergency situations.

The control centre's vital functions will be protected by way of duplication or redundancy so that no single equipment failure is capable of completely disabling the centre.

The OCC becomes a strategic centre for the management of degraded modes of operation by application of relevant procedures. Its functions are as follows:

- it assigns a permanent identification number to each train set put into service.
- it automatically sets routes from predefined timetables, corrects departure times to match timetables, detects deviations from schedule, identifies conflicts and informs the operator of them.
- it remotely controls the interlockings and therefore creates automatically or manually routes, and it sends instructions to the interlocking system. Nevertheless, the instruction is safely checked by the interlocking system and is implemented only when safe conditions are achieved.

38. STATIONS

New stations will be provided on the HSL at the terminus at Canberra and intermediate stations at Goulburn and Southern Highlands.

The terminus at Canberra is to be developed as a component of the airport master plan. This will facilitate the interlining between different transport modes.

The intermediate stations will consist of an island platform with two platform faces, one serving an up-loop and the other a down-loop.
The main line will be used to provide a through line to enable non-stopping trains to pass a stopping train safely.

Access to the island platforms will be by overhead pedestrian walkways. Suitable "easy access" and stair facilities will be provided.
All new station platforms will be on straight track throughout their length,

with minimum stepping distances between the train and platform edge.

Passenger assistance call points will be provided with direct access to the OCC. Additionally station public address systems will be controllable by either local station staff or the OCC dependent on whether the circumstances are routine or of an emergency nature.

The existing stations at Sydney Terminal, Domestic and International airports will provide interchange to other transport modes. The Sydney airport stations are on the New Southern Railway which is scheduled to enter service in mid 2000.

The facilities at the Sydney Terminal will be extensively renovated to ensure they provide appropriate amenities for the travelling public.

39. STABLING AREAS

While the OCC controls train operations of the entire HSL, control by OCC of the stabling yards, workshops and maintenance bases is limited to the reception and departure tracks.

A limited number of lineside signals will be provided for shunting purposes in the main depot area and at stations to facilitate train movements. These movements will be controlled by Local Traffic Control (LTC).

Dragging detection systems are to be installed between the train maintenance facilities and the main line in order to prevent a train with a hanging part from entering the main line of the HSL. These devices are linked to the signalling system to stop a train.

40. ELECTRIC TRACTION INFRASTRUCTURE

Speedrail's electric traction infrastructure supports a 25kv AC system and will be installed in accordance with European Standard EN 50122.

There is to be a double neutral section between the 1500V DC on Sydney Entry and the 25kV AC on the HSL. One section is earthed, the other is earthed through a diode. Trains will pass the section with all pantographs lowered. This is to preclude contact between 1,5kV DC and 25kV AC.

An Electro-Magnetic Compatibility control plan will be implemented to ensure that the system operates safely without detrimental electromagnetic interference.

Power supply connection interlocking is provided, where necessary, for the protection of the operation and maintenance staff.

The overhead line equipment is installed to a safety proven European system. It will have the capacity to be operated under designated maximum operating wind speed conditions.

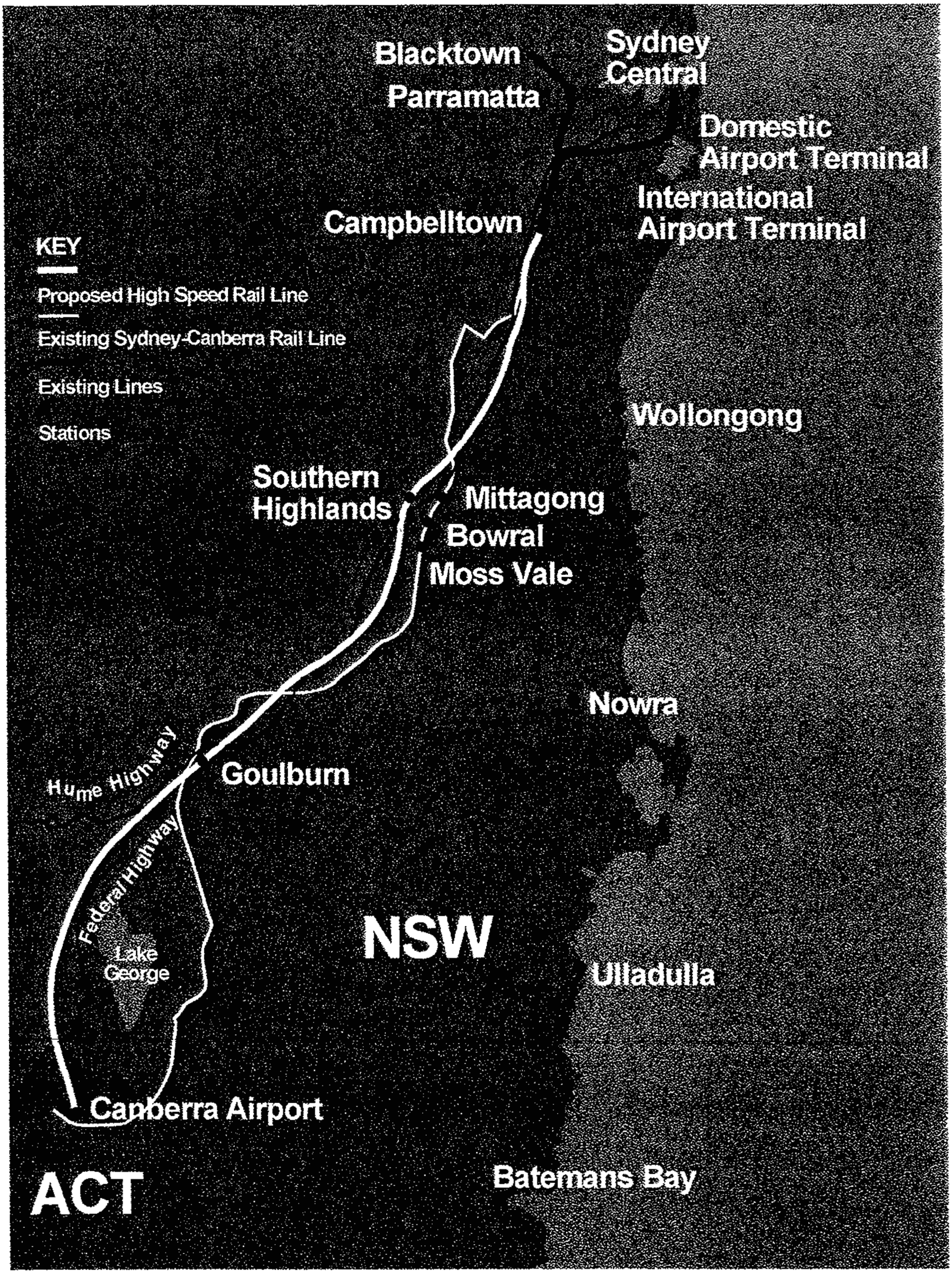
41. OPERATIONS ON THE SYDNEY ENTRY

All Speedrail's railway operations upon the RAC's network will be in compliance with RAC's safeworking requirements. The staff will also be in possession of the necessary competency to perform duties upon RAC's infrastructure, where necessary.

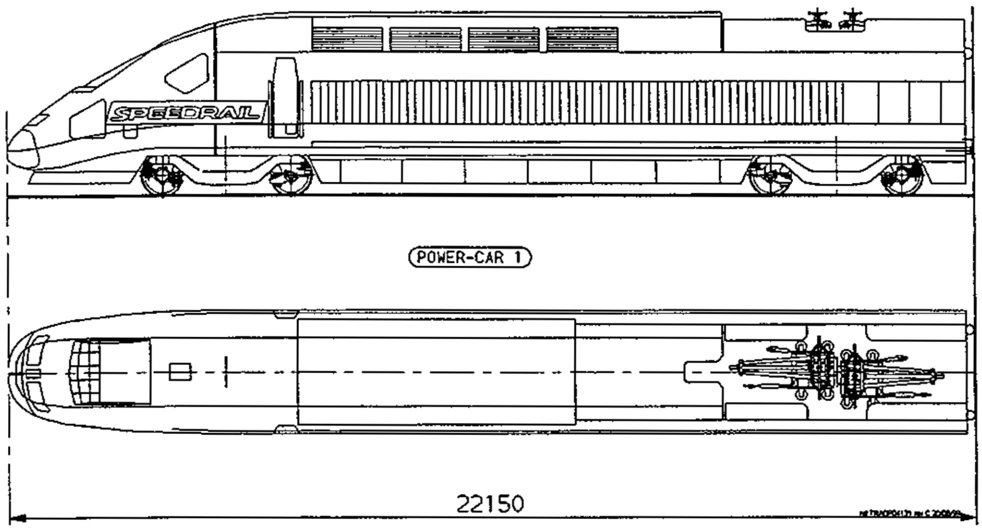
42. CONCLUSION

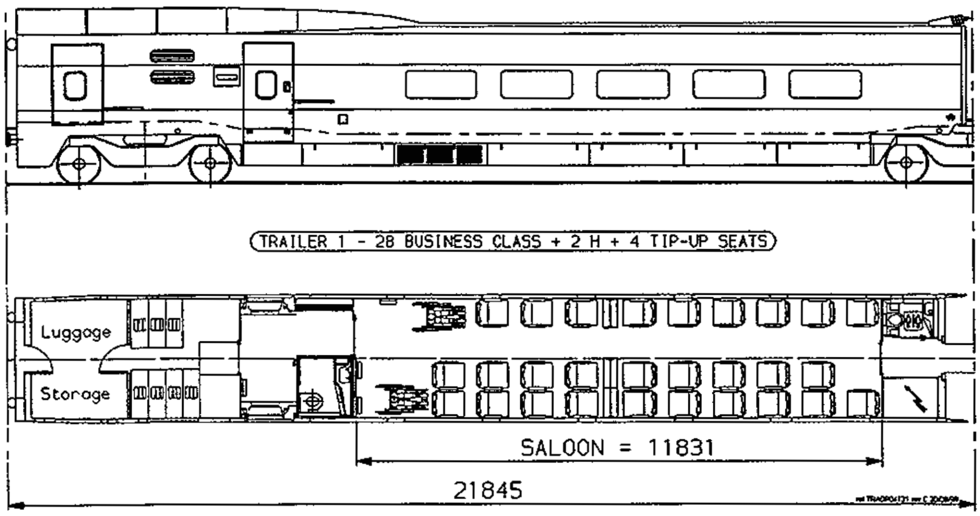
The development of Speedrail's safety management plan is an important element in the success of the Speedrail Project. When con-joined with the Railway Safety Principles document they will provide a suitable benchmark for future High Speed Operations in Australia.

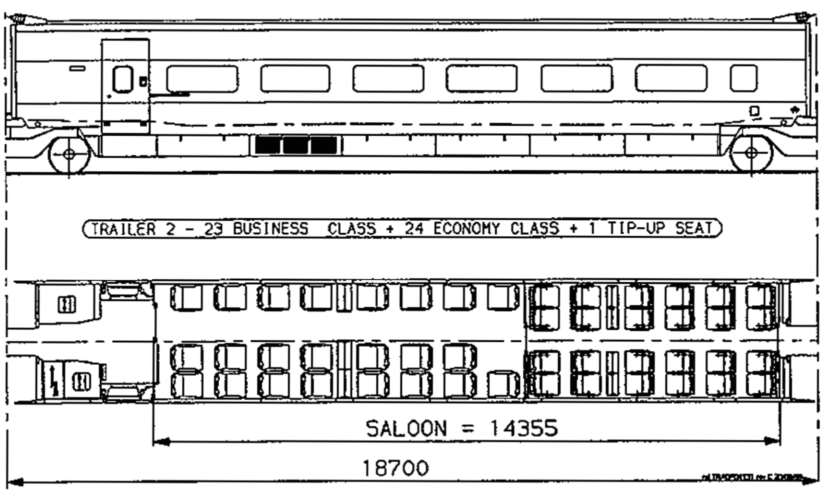
Although the Sydney-Canberra high speed rail service must and will succeed commercially on a stand alone basis, the Sydney-Canberra link is seen as the first stage in introducing high speed rail to south-eastern Australia. The infrastructure and technology used for the Sydney-Canberra link will be suitable for extensions to Melbourne and Brisbane with commercially viable journey times.


Blacktown
Sydney Central
Parramatta
Domestic Airport Terminal
International Airport Terminal
Campbelltown
KEY
Proposed High Speed Rail Line
Existing Sydney-Canberra Rail Line
Existing Lines
Stations
Wollongong
Southern Highlands
Mittagong
Bowral
Moss Vale
Nowra
Hume Highway
Goulburn
Federal Highway
Lake George
NSW
Ulladulla
Canberra Airport
ACT
Batemans Bay

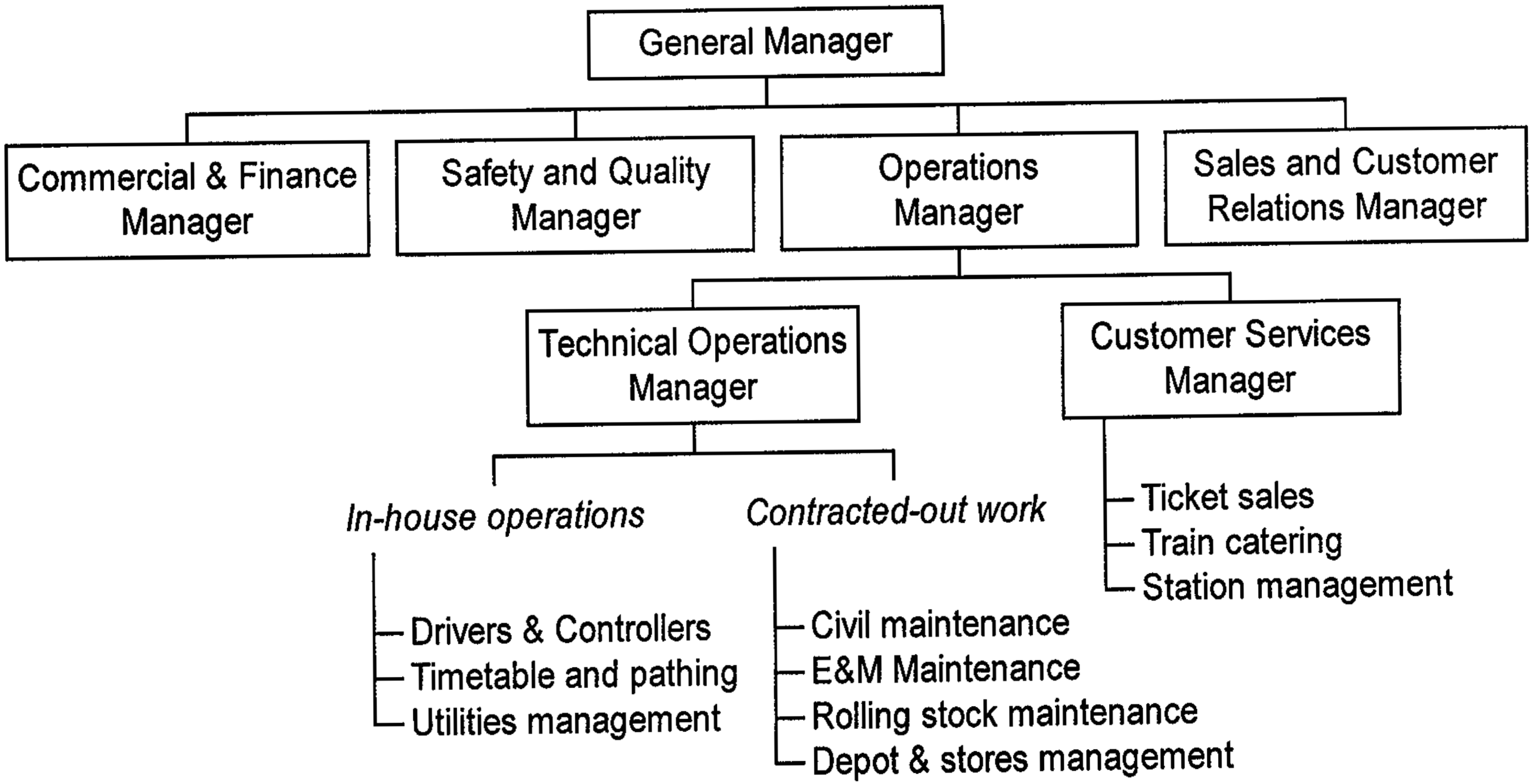
TYPICAL TGV DIAGRAM APPENDIX 2



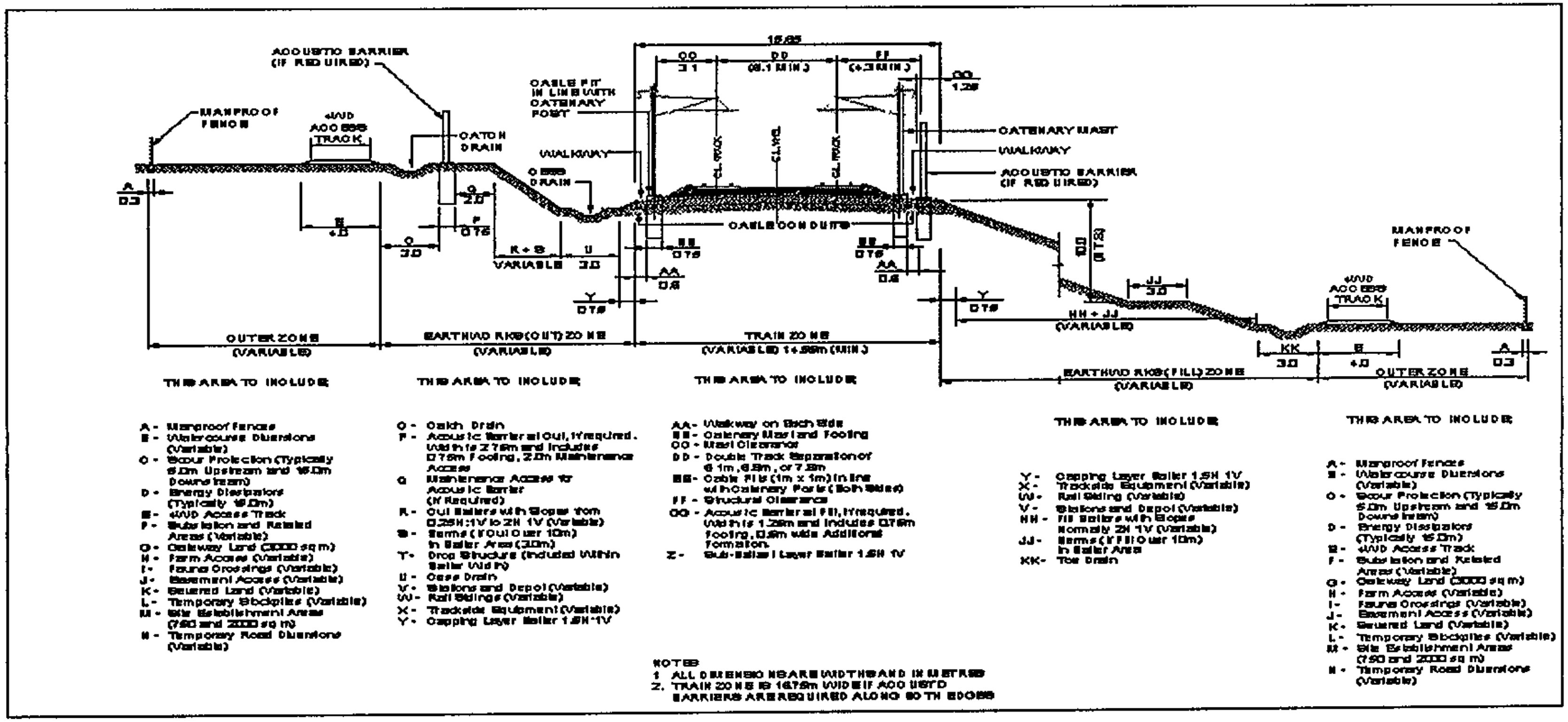




SPEEDRAIL GROUP PTY LTD - MANAGEMENT STRUCTURE APPENDIX 3

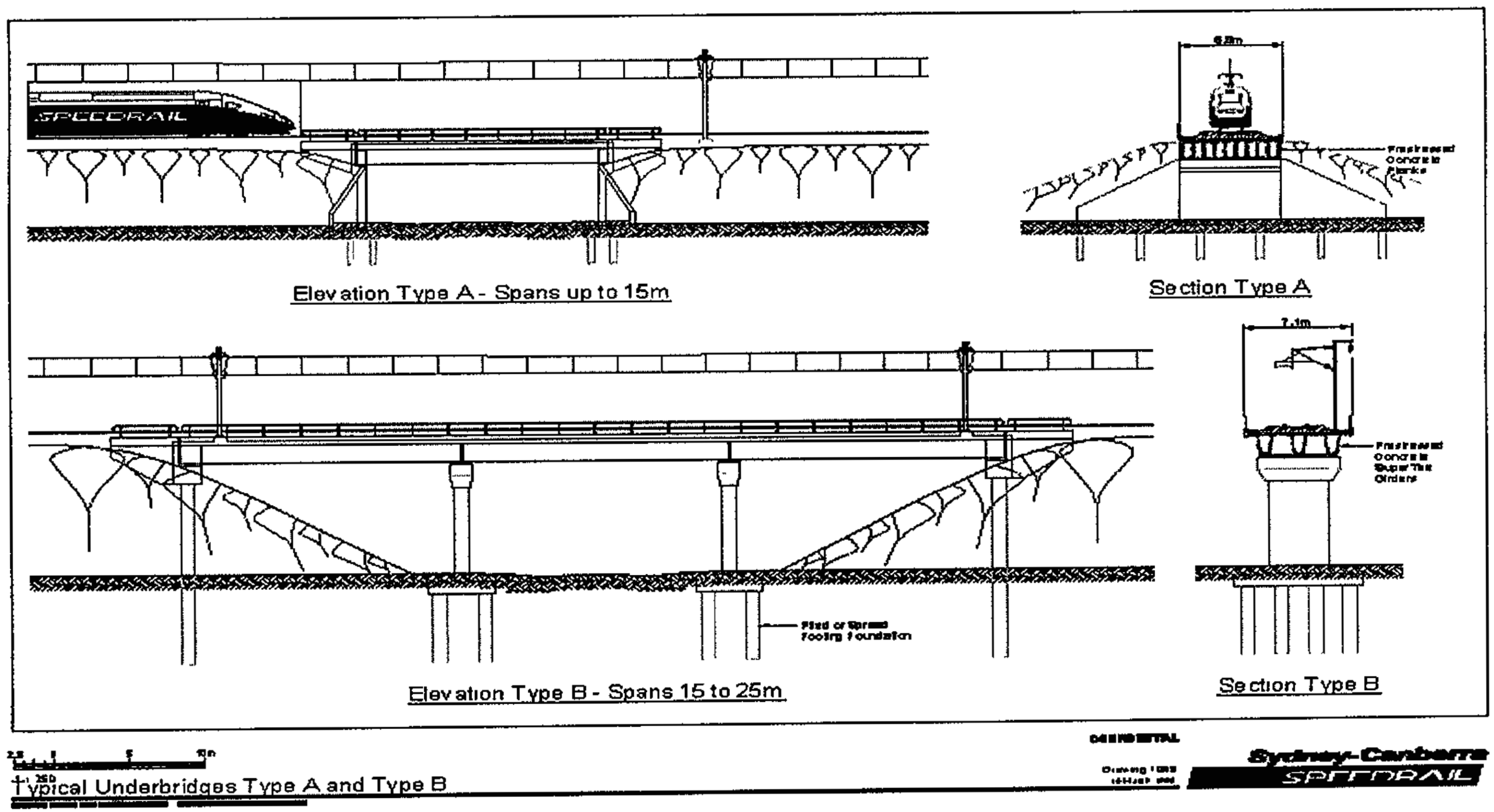


TYPICAL CROSS SECTION OF TRACK APPENDIX 4



Land Acquisition Model - Cross Section

Sydney-Canberra SPEEDRAIL


SPEEDRAIL
Elevation Type A - Spans up to 15m
Section Type A
7.1m
Elevation Type B - Spans 15 to 25m
Section Type B
Typical Underbridges Type A and Type B
Sydney-Canberra
SPEEDRAIL

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Paper 9912

Ms Catharina Lindahl

Managing Safety in a Changing World

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2000 International Rail Safety Conference

Curriculum vitae

Catharina Lindahl M.Sc
Head of Traffic Safety Department
Tågtrafikledningen, (The Swedish Rail Traffic Administration), Banverket (Swedish National Rail Administration)

Catharina Lindahl is a graduate from the Royal Institute of Technology in Stockholm with a Master of Science Degree in metallurgi.

Catharina has worked with the National Board of Occupational Safety and Health with safety questions concerning the steel industry, she has allso worked as a privat consultant in the steel industry and in heavy manufacturing industry.

She joined the Swedish State Railways in 1985. In 1988 the SJ was split up into a train operating company and an infrastructure manager. Shortly after that Catharina was appointed Senior Director at the Regional Director ´s Senior Staff.

In 1996 there was a reorganization , the state railway ifrastructure was opened to other companies besides SJ, and the neutral body Tågtrafikledningen (The Swedish Rail Traffic Administration) was created. Catharina was then appointed Head of the new Safety Department, responsible for traffic safety.

The Safety Department of Tågtrafikledningen 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.

1999-08-11

The 1999 International Rail Safety Conference

19th - 22nd October 1999
Banff Springs Hotel
Alberta, Canada

MANAGING SAFETY IN A CHANGING WORLD

Implementation of a new traffic safety organization

Catharina Lindahl M.Sc.
Head of Safety Department
Swedish Rail Traffic Administration

Implementation of a new traffic safety ORGANIZATION

1. INTRODUCTION

Sweden is a sparsely populated country with a population of some 9 million people on an area of 450 000 sqkms. It is characterized of long distances, urbanization and of big differences in climate conditions.

Sweden is highly industrialized. The traditional industry branches are ores, steelworks and steel manufacturing (especially car and truck manufacturing) and manufacturing based on vast forestry. All these heavy branches give an important base for rail transport over long distances-in domestic relations and from Sweden to the European continent and overseas. However, the rail transport is exposed to a strong competition from sea and road transport.

In the three main urban areas- Stockholm, Gothenburg and Malmö- commuter trains create important public transport systems, and between these three areas and in some other middle distance relations there is a competitive passenger traffic with trains with a rather high speed (up to 200 km/h)

The rail network-almost completely possessed by the State- consists of some 10000 km of route length. 75% of the route length is electrified, and some 15% are double or four tracked lines. All railway lines ın the State network are of standard gauge, 1435 mm.

2. SWEDISH TRANSPORTATION POLICY DECISION 1988

Based on the Government bill "Transport policy for the 1990s", the Swedish Parliament decided in 1988 on a new transport and environmental policy. This treated the future organization and financing of all transport sectors, and it related especially to the principles of socioeconomic evaluation, responsibility for transport costs, the relation to and influence upon environment and end energy and the need for public transport for everybody.

2.1 The road model

One goal of the proposal was to create equal competition conditions between road and rail transport. Road transport (freight and passenger by buses and coaches) was evidently subsided, because lorries and buses did not pay taxes enough to cover the costs they caused society. Thus they did not pay what they should for road investments and maintenance, for environmental disadvantages and for the consequences of accidents.

The proposal was to split of the Swedish State Railway into a public service enterprise- new SJ- and a State Rail Administration, Banverket (BV), responsible mainly for the infrastructure. The investment programs were to be decided on socioeconomic criteria. The train operators should pay charges for using the tracks. Those charges should be calculated on criteria corresponding to the road tax calculation.

2.2 The planning process

In order to upgrade the railway infrastructure substantially the investment and maintenance of the track system (including equipment for energy distribution, catenaries, signaling and telecommunication systems) was to be evaluated and decided on the total socioeconomic impact to society. Thus, investment planning was also to safeguard regional influence and the protection of the environment. Besides being responsible for the rail maintenance and necessary renewal, BV was to plan for and implement a modern railway system, performing more train capacity, higher speeds, higher axle loads, increased safety, less noise impact etc. BV was to decide priorities between investments in the trunk system as well as design and construct the new projects.

The planning work within BV should result in a proposal to the Government on a 10-year investment plan. This plan is actualized every 4th year, but it is always looking 10 years ahead. The Government approves the plan. The intention is that the Parliament will allow grants yearly to BV for financing the projects in the plan.

2.2 Experiences of the split in 1988

The new transport policy and the more open model of planning and decisions led to an increasing interest from the politicians to invest in the railway infrastructure. E g in 1995 the investment amount was about 10 times the amount in 1988, and it remains in a rather high but decreasing level.

Some major projects during the 90s are:
- Upgrading to 200 km/h on several main lines
- Double tracking on the West Coast Main line Gothenburg-Malmö and on parts of the Northern line Stockholm-Gävle-Ånge.
- Partly new lines combined with upgrading and double tracking around the lake Mälaren close to Stockholm
- Capacity increasment for the commuter train systems in Stockholm, Gothenburg, Malmö and Norrköping.
- Railway to Arlanda airport (in cooperation with a private consortium)
- Upgrading for 25 t axle load on major parts of the main lines, 30 t on the Iron Ore Line between Luleå and Narvik in Norway.
- Expansion of CTC and radio systems

Last, but not least, the new bridge and tunnel link "Öresund link" between Malmö and Copenhagen has to be mentioned.

3. FURTHER DEREGULATION

Due to the political course in EU and in Sweden, there was decided on forthgoing liberalization of rail transport. Further competition within the railway sector was a guideline. The access rules had to be changed. The remaining parts of monopoly for SJ should be minimized. SJ should be considered as an operator among others.

5

In the years 1995-1998 several decisions to revise the rail transport policy were taken. The main results are:

Passenger traffic

- SJ still has the traffic right for commercial long distance passenger traffic. SJ keeps this right as long as they want to operate. If the traffic is not profitable for SJ, they are not obliged to operate it, and another operator might get the access.
- The county transport authorities has the traffic right within each county (and sometimes also in neighbor counties). They may operate their trains themselves or purchase the traffic from any licensed train operator.
- State purchased traffic (for regional welfare reasons) might be purchased from any licensed operator. A new State authority has been introduced for purchasing non-profitable long distance traffic and making necessary coordination between county traffic systems.

Freight traffic

- The right to operate freight traffic is open to any licensed operator.

Charges for using the infrastructure.

The principles of the road model are still valid. However, better knowledge on the impact on society of different transport modes, has caused a modernization of the infrastructure charging system. The new charges should correspond to the socioeconomic margin cost for operating trains. The total level of rail infrastructure fees have been reduced ca 75%, while road taxes for trucks and buses have increased slightly.

Increased importance of the roll of the National Rail Administration (Banverket)

The National Rail Administration is the central management authority in matters related to railways. The Administration is instructed by the Parliament and the Government to promote the development of the railways, to operate and manage the State railway infrastructure, to manage track allocation and safety matters for rail traffic and to promote environmentally appropriate railway traffic.

Track allocation and traffic control

The responsibility for track allocation, timetable establishment and traffic control is now organized in a new unit within the National Rail Administration. It is called the Swedish Rail Traffic Administration, and it is independent from other parts of BV in the sense that it acts as an arbitrator when BV and the railway undertakings operating on the state owned infrastructure cannot agree upon the timetabeling and distribution of time allocated for train operation and for track work.

Common facilities

It shall be possible to use the common facilities on competitively neutral and non-discriminating terms. Therefore there is a program for transferring some facilities from SJ to BV; e g freight tracks to terminals, and for giving rules providing different operators traffic on SJ-owned stations.

4. WHAT HAPPENED WITHIN THE COMPANIES

The transportation policy decision 1988 led, as mentioned earlier, to a split of the national railway into one public service enterprise- new SJ- and a State Rail Administration, (BV). Due to several reasons, the infrastructure company was for example not ready to take over the responsibility partly due to lack of competence in traffic related matters, the traffic control organization remained within SJ.

After the division, the two parts evolved in different ways. The new SJ recruited new top management from the private industry but remained in its strong centralized organization. Most of the competence concerning traffic and traffic safety questions had stayed within SJ, and the responsibility to maintain the traffic safety rule book and safety regulations was handled by the old safety staff of SJ. The evolution of the safety regulations was governed mainly by demands from the own organization and from the Rail Inspectorate due to accidents and incidents.

BV applied a decentralized approach with clear aims and a strong delegation of responsibility to the regions. This was necessary in order to manage the great amount of investment they had to handle. The big investments caused a rapid change s in technology. This made it necessary for the personnel of BV to understand the function of the safety equipment and signaling systems, but there sometimes was a lack of understanding of the traffic processes and the old safety regulations. New technique that didn't fully mach the old safety rulebook, or which couldn't be fully used due to the old rules, was sometimes introduced.

The decisions in 1996 brought new changes.
When the State railway infrastructure was opened to other traffic companies besides SJ it was necessary to create a neutral, non-discriminatory body for track allocation and traffic control. The Rail Traffic Administration, T, was formed with new management recruited from BV and SJ. After a short time the Traffic Administration took over the entire traffic control organization from SJ (approximately 1100 persons, mostly train dispatchers), without any organizational changes. This made the differences in organization and safety philosophy between SJ and BV clear to us, working in the Traffic Administration.

Within SJ, the traffic control organization had been made a body of it's own, though it, in many aspects had remained under the management of the strong central staffs of SJ. The traffic safety awareness among the personnel was high, but it was a rule-based knowledge depending on detailed information and instructions from the safety staff.

Till now the safety staff of SJ had managed the traffic safety rule book and safety regulations. Now the responsibility for these regulations was transferred to the director general for BV.

5. THE PROBLEMS WE, THE RAIL TRAFFIC ADMINISTRATION, ARE FACING TODAY

Today the Traffic Administration is facing several difficulties that has to be solved in order to create a rational, safe and modern organization that can meet the demands from the changing railway market:

- As a result of the organizational heritage from SJ the traffic control organization has too few employees with management competence in the regional organization. This resulting in difficulties when communicating new requirements and goals.

- Most of the overall traffic safety competence concerning traffic and traffic control was placed in the central safety staff of SJ and stayed there when the traffic control organization was transferred to T.

- The traffic safety rule book and safety regulations were written for a situation with one traffic operator, and that operator wrote it. This has led to a mix of safety rules and operational practice and confusion about roles and responsibilities.

- The traffic safety rule book and safety regulations are extremely detailed and hasn't kept up pace with the technical and organizational development.

- Drivers and people working out in track (as well as, sometimes, the traffic safety rule book) tend to overestimate the train dispatchers possibilities to control the situation out in the track.

- The liberalization of the railway market has led to a need for further regulation.

- Many of the tools for traffic control are integrated with SJ's IT-systems. This makes it difficult to handle other operators efficiently.

6. WHAT HAVE WE DONE AND WHAT ARE WE DOING

This new situation within the Swedish railways does not only give us problems; it also creates new possibilities to new solutions and will hopefully lead to a more rational, safe and modern organization of the whole railway system. We are just in the beginning of the process to solve our problems and some of the examples of what we, in the Rail Traffic Administration are doing are:

- Education of personnel
  - Technique, closer contact with the technical departments of BV has led to new, additional training for train dispatchers and safety instructors.
  - Roll and responsibility

- System for safety audits and feedback to the organization
  -

- New IT-systems
  - Non-discriminating, makes it possible for us to treat all operators in a neutral way, also makes it possible for us to construct better and more efficient systems.
  - Better man-machine interface, closer contact with the technical departments of BV will hopefully make this possible
  -

- New safety rulebook, BV has the responsibility for the overall rulebook; the Rail Traffic Administration will handle the rules concerning our internal work. That covers approximately 30 % of today's rulebook. Some of the key words for the work are:
  - User-friendly

  Based on modern technique and organization

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Dr Mike Maynard

Safety Review of Organisational Change in London Underground

Publisher
2000 International Rail Safety Conference

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Safety Quality & Environment Department
London Underground

Mike Maynard is General Manager of the Safety Quality and Environment Department within the recently reorganised London Underground. He is a member of the team which has been carrying out a review of the safety aspects of the design and implementation of the reorganisation, which is the subject of the paper presented here.

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.

1999 International Rail Safety Conference

Safety Review of Organisational Change in London Underground

Mike Maynard
Safety, Quality & Environment Department
London Underground

1. Introduction

London Underground Ltd (LUL) operates an urban railway rapid transit system over some 400 route kilometres serving over 270 stations. Over 40% of the route is within tunnels which are constructed by either 'cut-and-cover' or deep level tube boring. In 98/99 61 million train kilometres were run and 866 million passenger journeys made. Annual passenger journeys on the system have increased by 100 million since 1994/95.

The first 'cut-and-cover' sections of what was to become London Underground were constructed in the 1860's. The first tube section was constructed in the 1890's. The early 1900's saw the construction of further tube lines, and in the following decades the extension of the lines to London suburbs.

Although there are modern parts of the network, notably the extension to the Jubilee Line which is undergoing phased opening in the second half of 1999, much of the London Underground network is old and requires considerable maintenance and improvement investment

In order to provide this long term investment the UK Government has decided that a Public-Private Partnership (PPP) will be formed. For this Partnership, London Underground Limited will be restructured into three private sector Infrastructure maintenance and upgrade companies, and a new LU public sector operator. The Infrastructure companies will have long leases of the Underground's fixed and moveable operational assets, and will have contracts to maintain and improve these assets

In preparation for this London Underground has been going through a major organisational restructuring programme. The intention has been to establish shadow organisations within LUL so that a measure of testing the effectiveness of the future arrangements could be undertaken prior to the letting of Infrastructure contracts. This paper describes the approach taken by LUL to assure itself that safety risks during and following the organisational change have been identified and suitably controlled.

2. LUL's Approach to the Safety Review of Change

LUL as a vertically integrated controller of railway infrastructure and a train and station operator can undertake its operations only on the basis that it has a Safety Case accepted by HM Railway Inspectorate (HMRI). The Regulations laying down this requirement also require any changes which would render the Safety Case materially different from the last version to be accepted by the HMRI before the change is made.

The Health, Safety & Environmental (HSE) Management System in place in LUL contains a specific Directive and Code of Practice on the safety review and control of change This addresses all aspects of change including operational, engineering, and organisational and management changes. Where the failure to adequately conceive, plan, or implement a change could introduce safety risks there is a requirement for a case for safety to be prepared. Cases for safety provide the safety justification for a change by presenting the findings of the safety risk assessment and any conditions which must be met to assure safety during or after the implementation of the change.

For the more significant changes, which are identified through a structured categorisation of potential safety significance, an internal peer review body of suitably competent and representative senior managers reviews the case for safety and identifies any concerns affecting the acceptability of the case. Only when LUL has assured itself of the case for safety will a change be submitted to HMRI for its acceptance where required.

3. Specific Approach to Safety Review of the PPP Organisational Change

3.1 Organisational Safety Review Team

The existing safety review and change control processes established within the HSE Management System provided a sound basis for the safety validation of the design and implementation of the new organisational arrangements. However, the Boards of LUL and its parent body, London Transport, decided to set up a specific senior management peer review team. The terms of reference of this Organisational Safety Review Team included:

a) reviewing the cases for safety developed by the organisational design teams, to include consideration of:

- i) the new organisational structures,
- ii) the interfaces within and between the new organisations,
- iii) the transition to the new organisation, and
- iv) the resources available to the new organisations.

b) maintaining a watching brief to ensure that risks are controlled during transition,

c) reviewing and signing off the revised LUL Safety Case for submission to HMRI,

d) having powers to send back to the organisational design teams any issue which it deemed unacceptable from a safety point of view.

The Review Team is chaired by the LT Head of Safety and includes senior members from the Operational, Engineering, and Safety functions of LUL who have experience in carrying out such peer reviews. The Team also includes a member from a private sector organisation external to LT/LUL who has wide experience in safety risk matters across a range of industries, and who has knowledge of the experience of the privatisation of the National railway in the UK. The decision to include an experienced external member was based on a desire to bring to the team:

a) a questioning of the LUL perspective of the way risks are currently shaped and controlled,

b) a wider understanding of private sector culture, and

c) a wider perspective on the issues presented by major contractor interfaces.

Our experience has been that the external member has provided a valuable input to the Review Team.

3.2 Interaction between the Organisational Design Teams and the Review Team

The established principle in LUL is that it is the responsibility of those proposing change to assess the safety risks and make the case for safety. However, in recognition of the wide ranging scope of the planned Company reorganisation, the Review Team worked closely with the design teams from the outset. In particular:

a) Joint workshops were held to identify the expectations of the Review Team and the support needed by the design teams.

b) The Review Team organised a design team seminar given by a leading UK expert on Designing for Human and Organisational Factors.

c) Joint exercises were held where the practical application of proposed new arrangements in areas such as Assurance, Incident Management, and Access were tested by running through Table-Top scenarios.

As a result of the early involvement of the Review Team it was recognised that there was no overall safety co-ordination of the various teams looking at various aspects of the design of the new organisations. As a result of the Review Team's recommendation, a senior manager with a background in safety leadership was appointed to provide this overall co-ordination.

In general the Review Team considers the proposals from the Design Teams in panel sessions where written cases for safety are presented and discussed. Typically cases are initially accepted subject to a number of caveats which must be addressed by the design teams. These caveats are formally minuted and entered on to an Issues Register. These are closed out, depending on the nature of the issues, by a re-submission to the Review Team of the whole case, or a report back on the resolution of the issues raised, or by a member of the Review Team visiting parts of the business to talk to individuals affected or to examine documents

4. Managers' Safety Responsibilities

As one example of the many issues that have arisen from the design work and the review of the proposals for the new organisations; a key issue has been to understand the managerial responsibilities for essential critical duties and functions which currently shape and control safety risks on the LUL system, and to map these across the new interfaces of the new organisations.

In a mature organisation like LUL, these responsibilities have evolved over time and are comprehensive. However, not all the responsibilities are clearly recorded, for example in Job Descriptions, but have been passed down as part of the succession of new managers to the posts At a time of major organisational change, involving eventually a disaggregation of one organisation into four working under contractual arrangements, it was felt that a clear mapping of safety responsibilities was essential

Fortunately, LUL has a well developed Quantitative Risk Assessment (QRA) model of its major accident risks. The QRA consists of extensive fault and event trees which give a structured representation of what prevents initiating events which could lead to an accident, what protects against those events should they occur, and what mitigating actions control the consequences.

Work has been carried out to map top level accountabilities against all the risk controls within the QRA, and to assign responsibilities for the key management actions required to implement these controls. As part of this the key dependencies on the actions of others for the successful execution of these responsibilities have been identified. This work, together with the identification of the safety responsibilities of particular managers with regard to particular aspects of the HSE management system such as Standards and Assurance, has provided a systematic mapping of senior managers' safety responsibilities. This will provide the basis for them to cascade the risk mapping of safety responsibilities to those managers to whom they delegate.

5. Status of the Design and Review

At the time of writing this paper, cases for safety for a wide range of the aspects of the transition to the new organisational structures and arrangements and shadow running of the new structures are well developed As an illustration, these have covered aspects such as:

i) Arrangements for ensuring competent back-filling resources for those seconded to organisational design teams or undertaking roles as designate managers in the new organisations.
ii) Allocation of infrastructure and assets to the three Infrastructure organisations.
iii) Structure of the Infrastructure and Operating organisations and their key interfaces.
iv) Allocation of scarce resources within the new Organisations and the trading agreements/contractual arrangements associated with this.
v) Provision of Safety Leadership training to designate Directors and senior managers in the new organisations.
vi) Corporate Governance structures and the allocation of safety accountabilities and responsibilities (see the discussion in Section 4).
vii) Safety Assurance arrangements.
viii) Safety arrangements within the PPP contractual framework including matters such as.
   a) Safety Case regimes for the Infrastructure companies,
   b) Safety Agreement,
   c) Regime for Standards in the PPP,
   d) Remedies for contractual default.
ix) Review of the resources and budgets for the new organisations at the commencement of the shadow running period.

The LUL Railway Safety Case has been rewritten to reflect the new structures and arrangements. This will be reviewed by the Review Team before being sent to the LT/LUL Boards for approval. Acceptance of this revised Safety Case by the regulatory authorities is required before the changes can be implemented

6. Conclusion

The work to restructure LUL has been a mammoth undertaking in a relatively short space of time. The application of LUL's Safety Review processes and the need to satisfy the Review Team of the case for safety has placed burdens on the design teams to demonstrate that the potential safety risks arising from the change have been identified and that the new arrangements proposed will ensure that safety risks are managed to a level which is as low as reasonably practicable. The number of issues which have been identified as requiring resolution provide evidence that the structured approach adopted has been worthwhile Further, the consideration of safety as the design develops (and the early identification of the issues this allows) rather than as a back-end review has also helped to manage the risk to the overall programme from safety concerns.

I hope, by the time of presenting this paper to the Conference, to report that we have made the case for safety for the start of the shadow running of the new organisations to the satisfaction of both LUL and it's Regulators.

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Paper 9914

Gerald Churchill

A New Approach to Risk Management at the RATP

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August 1999

Background

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 coordination, 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 equipments of 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).

International Seminar on Railway Safety
BANFF, CANADA

October 19 - 22 1999

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A New Approach to Risk Management at the RATP

In 1996, the RATP was confronted with several serious incidents, fortunately without loss of life, but nevertheless sufficiently recurrent to be of concern to the company's General Management. A group of experts was then formed to examine the causes of these incidents and propose measures to prevent their recurrence.

The conclusions of this working party were remitted to the General Management in December 1997.

Despite its maxim, taken from Virgil's Georgics: "Felix qui rerum potuit cognoscere causas" (Happy is he who can know the cause of things), the group pinpointed several weak points in the company, arising from the drawbacks of the experimental method and the oral tradition, the lack of a system approach and non-transparency of responsibility.

Five main recommendations were made:

- adoption of a risk management approach,
- an approach of a processes in its entirety,
- systematic substitution of a written culture for the present, mainly oral, culture,
- adaptation of training methods and tools for those involved,
- more intensive integration of a quality approach in daily activity.

On the basis of these observations, the RATP Chairman and Managing Director created a General Delegation for System Risk Management (Délégation Générale à la Maîtrise des Risques Système : DGMRS) directly answerable to himself, to implement the working party's recommendations. This delegation is composed of representatives from each of the company's main operational sectors.

The DGMRS is essentially a structure for guidance and for inspiring ideas, the main missions of which are:

- promoting and developing the risk control culture in the company, concentrating on improving interfaces and initiating new forms of training action;
- deciding on measures to be adopted after examining system risks, in concertation with the operational and maintenance sectors. These are mainly in the form of recommendations on interfaces having an impact on safety;
- intervening, at the request of the operational Departments or the General Management, to carry out specific inquiries on railway safety matters, and making in-depth analyses of the critical events occurring on RATP networks.

There is nothing particularly original in this change of organisation within the company when it is compared with that of other large rail transportation companies. It merely confirms that railway safety must be one of General Management's major concerns, and that all management levels in the company must make every effort to achieve and pay particular heed to safety, for in this area more than in any other, nothing is ever accomplished once and for all.

In what follows, I will not go into all the action which has been undertaken following this change of approach by the RATP, but merely cite three concrete examples which offer particular features.

Risk management and « learning from experience »

If the oral tradition is to be supplanted by a written one and a risk management approach is to be encouraged, then each significant new project or change in existing structures and usages must provide for a preliminary risk analysis, first for the project as a whole, and then for each technical development.

This document, which is added to as the project advances, constitutes a fundamental component of the "safety log".

At the end of the project, the study, in which every identified risk is clearly covered by constructive solutions or operating or maintenance requirements, constitutes the elementary risk analysis of the new or modified system.

The intention of the company is for this document not to end up in a cupboard when the project structure moves into the operational structure phase, but that it become the true "safety log". One solution for avoiding relegation is to add to it with « learning from experience ».

Practically speaking, the Department of Electrical Equipment and Systems in charge of system studies and safety in railway systems, has set up the practice of bimestrial « learning from experience » reviews, operating on this principle.

Every two months, major incidents in the network are analysed, and a maximum of three to five recommendations are derived from them and introduced into the elementary risk analyses concerned.

The elementary risk analysis thus becomes a living, well-thumbed reference document.

Information and training

As early as 1996, the RATP decided to place its know-how and experience into an in-house guide. This relatively voluminous guide, which started off in a single volume, soon spread to two. The first contains operating safety policy in design, realisation, operation and maintenance. The second is a collection of methods and tools, including a description, advice, and examples of applications. The latter also contains basic internal and external statistical data.

Some of the difficulties of this guide, common to all documentary approaches of this nature, are its dissemination and its updating. The remedy found by the DGMRS is digital diffusion via the company's Intranet network. Our Intranet site is currently being created. It should allow virtually all employees in the company to be reached, and will be capable of meeting employees' specific needs by making available high-performance navigation tools.

This tool is designed above all for management. A more educational approach was adopted for operating and maintenance staff, based on a simple, mnemotechnical approach. The support selected is comparable to the Ten Commandments in its form and finality, offering a simple, unambiguous message placing responsibility where it belongs.

Two examples of this are:

"I shall comply with procedures scrupulously"
"When I check the results of my action, I shall never trust the person who has carried it out, especially if that person was me".

Each of these commandments will be illustrated by a small film based on a true experience, or a cartoon strip or any other modern support for communication; and will be tools for training courses to be organised for the various categories of staff.

In addition to the guide, a similar training scheme will be set up for management, completing the "ten commandments" with the general principles behind them.

Two examples of this are:
"Any activity having an impact on safety must be identified clearly".
"No safety equipment shall be modified on the initiative of units in charge of realisation and maintenance alone".

Indicators and Benchmarking

Management of risky situations is much easier where it is possible to anticipate them. However, it is very difficult to obtain a relevant indicator to meet these needs in railway technology, for such events are rare.

To endeavour to progress in this area, the RATP began a research project early 1999, in association with the Ecole Nationale Supérieure des Mines (a higher engineering school) in PARIS. The subject of this research is how to define an indicator of the degree of danger.

The indicator is based on follow-up of changes in a number of precursors (near-misses) selected for their relevance, the ease with which they can be followed up and the accurate representation of the different parts of a transportation system (technology, men, environment). Examples of precursors are:

- excess speed,
- signals passed at danger,
- recurrence,
- fires starting,
- track, rolling stock and fixed installation incidents.

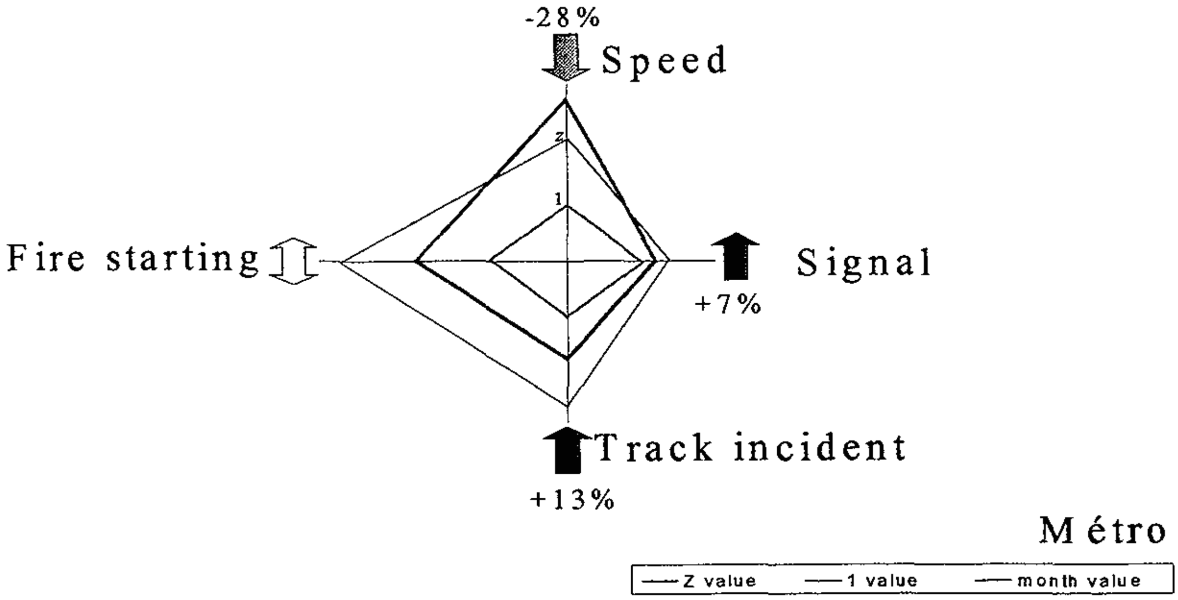
Each indicator is tracked monthly, whatever the season, for ease of comparison. The range of indicator variation is divided into three segments:

- a lower range corresponding to the desired operating mode. This is the requirement range.
- a middle range corresponding to an operating mode requiring particular attention. This is known as the vigilance range.
- an upper range which corresponds to an operating mode giving rise to concern. It is the alert range.

Each indicator is normed. Value 1 is the limit between the lower and middle ranges. A threshold z specific to each indicator is the limit between the middle and upper ranges. Value z is determined using previous observations according to a statistical approach which does not concern us here.

Where the indicator for one month crosses threshold value z, the various players in the company are alerted because this shows that the chain leading to an accident is building up. Therefore, it is time to act.

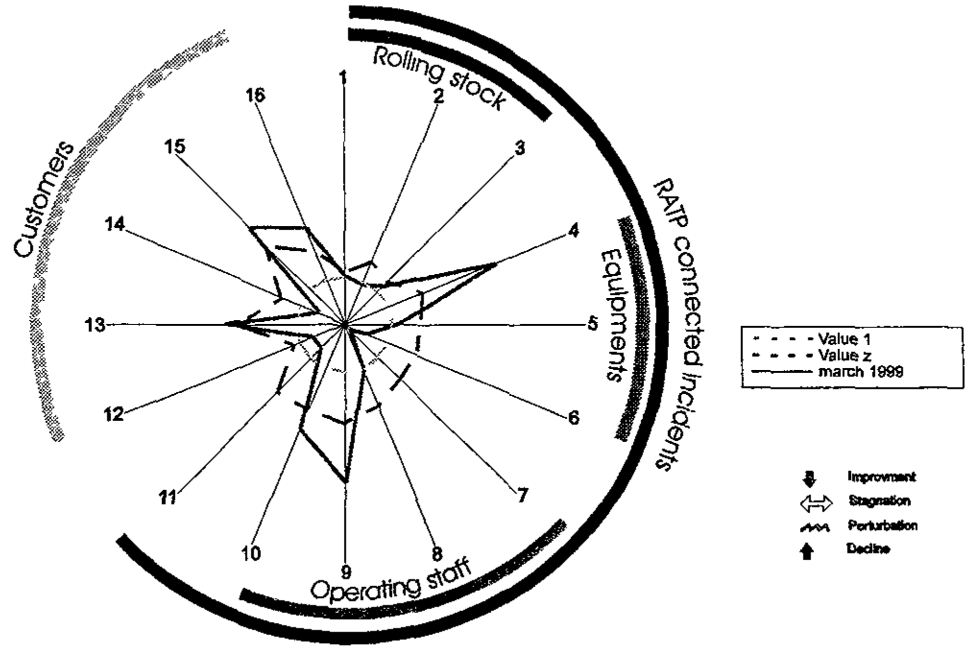
We plan later on to calculate the sliding indicators over the longer term, to reveal imperceptible trends. The following diagram gives an example of the complete indicator for February 1999 in the Metro network.



This indicator is now in operation and has already shown its worth. A real application has been developed on the RER (RATP regional express peri-urban network), as can be seen in the next diagram:

RATP RER A

Mission Sécurité Ferroviaire



Indicator	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
Short term change (4 last months)	↓	∿	⇔	↑	↓	∿	⇔	↑	↓	↑	∿	⇔	↑	⇔	∿	↓
Long term change (12 last months)	2 %	1,5 %	2 %	1 %	2 %	2 %	1 %	2 %	2 %	1 %	2 %	2 %	2 %	2,2 %	1 %	1,5 %

This tool is well tolerated by the operating managers who use it as a local management aid, which is one of the goals sought.

Once the indicator is operational, it will constitute part of a benchmark used by other networks.

Meanwhile, more immediate action has been undertaken at company level. This is the creation of an international network of correspondents for railway safety, communicating via INTERNET. The idea is this:

- to involve a maximum number of networks,
- to involve those people really concerned,
- to work on very short questionnaires (under 1 page)
- to work quickly due to digital exchanges,
- to go into questions in more depth where necessary with the networks concerned,
- not to become tied down by the administrative constraints of already existing associations such as the UIC or the UITP.

The data base of correspondents is currently being built up from a hard core of the eight largest metro networks in the world (COMET) and could be extended to the networks participating in this conference.

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Banff Springs Hotel, Banff National Park, Alberta, Canada

Paper 9915

Jim Shultz

CSX Transportation's New Compact with Employees: How we are changing safety culture

Publisher
2000 International Rail Safety Conference

James T. Schultz

Vice President and Chief Safety Officer
CSX Transportation
Jacksonville, Florida

Date of Employment by CSX (or predecessor): October, 1997
Date of Birth: February 13, 1949
Place of Birth: Columbus, Ohio

Education: Arizona State University, B.S., Political Science, 1972
Webster University, M.A., Public Administration, 1976
University of Southern California, postgraduate studies in Public Administration, 1977

Employment before CSX:

1972 to 1979 F4 Phantom Jet Fighter Pilot; Security Operations Officer, USAF, Overseas
1979 to 1980 Manufacturing Manager, Procter and Gamble
1980 to 1986 Director-Special Projects, Chicago and North Western Railway
Trainmaster, Chicago and North Western Railway
System Safety/Rules Officer, Chicago and North Western Railway
1986 to 1998 Railroad Safety Inspector (Operating Practices), Federal Railroad Administration, Los Angeles and Chicago
Railroad Safety Specialist (Operating Practices), Federal Railroad Administration, Washington DC, HQ
Division Chief-Operating Practices, Federal Railroad Administration, Washington DC, HQ
Staff Director-Operating Practices, Federal Railroad Administration, Washington DC, HQ
Regional Administrator-FRA Western Region, Federal Railroad Administration, HQ at Sacramento, Ca.
Associate Administrator for Safety, Federal Railroad Administration, Washington DC, HQ (SES)

Chronology of CSX Employment:

1997 to present Vice President and Chief Safety Officer, CSX Transportation, Jacksonville

Awards/Honors: Former member of U. S. Senior Executive Service; Governor's Award for Leadership; Academic First Honors; USAF Security Officer of the Year; Who's Who Among Students in Colleges and Universities; Top 10% graduate-USAF jet pilot training; U. S Jaycees "Outstanding Young Man of America"; Graduation Speaker and Member of Federal Executive Institute Class 217; FRA Superior Performance Awards; FRA Administrator's Special Recognition Awards, FRA Superior Performance Team Awards; Secretary's Silver Medal.

Business, Civic and Professional Affiliations: *Board of Directors:* Jacksonville Urban League, Prevent Blindness of Florida; *Member:* Federal Executive Institute Alumni Association

Family: Wife-Constance, Son-Jason, Daughters-Lisa and Erin

"CSX Transportation's New Compact with Employees: How We Are Changing Safety Culture"

by
James T. Schultz
Vice President and Chief Safety Officer
CSX Transportation
Jacksonville, Florida

1999 International Rail Safety Conference
Banff Springs, Alberta, Canada
October 21, 1999

A LONG HISTORY OF ACHIEVEMENT

The railroad industry has an impressive record of safety improvements. Numbers and the severity of injuries, deaths, and train collisions have decreased at significant rates in the past decade. But that isn't enough. Zero tolerance for any casualty is our ultimate benchmark. Unfortunately, all the easy fixes have been made. We need to find new and better ways to continue to improve safety in the coming years.

At CSXT we have launched a new era of cooperation within our railroad team. Our managers, our labor leaders, and our employees are collectively engaged to find ways to work better together on common ground issues like safety, service, and quality of work life enhancements.

A NEW WAY OF THINKING ABOUT EACH OTHER

CSXT's roots go back 172 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 , labor-management relations in the industry have been characterized by tension and mistrust. Now, as the industry strives to capture new opportunities for growth, railroad employees, labor union leaders, and rail management, have joined together at CSX Transportation in a new spirit of cooperation.

We call it our "New Compact with Employees." This isn't just another theory, catchy phrase, or management restructuring. It is we tackled, with today's union driven safety programs as an outgrowth. While we are at the very early stages of these employee based programs, we are confident that with time, we will see significant progress toward our goal of becoming a "zero tolerance" railroad.

A DRAMATIC FIRST STEP

In one bold step, CSXT and labor organizations representing a majority of our employees broke away from outdated policies and inaugurated a 21st century approach to employee performance. On July 1, 1998, CSXT, the United Transportation Union and the Brotherhood of Locomotive Engineers became the first in the nation to jointly develop and implement a new policy that replaces former railroad disciplinary procedure.

The new "*Individual Development and Personal Accountability Policy*" has moved the company from a unilateral approach to one of partnership with the operating craft organizations. Positive corrective action — not punishment — is the cornerstone of the new policy.

A minor rules infraction is now addressed jointly by the local CSXT manager and the union local chairman. Repeated minor offenses and first-time serious rules violations are handled through non-punitive methods, such as "Incident Review Committees" and "Time-Out" sessions. Only in cases of continued serious offenses or egregious rules violations will the new policy require formal hearings under the terms of the applicable collective bargaining agreement.

Our other labor organizations have since joined the ranks of supporters of this new collaborative approach, which has been attracting attention nationwide, both inside and outside the rail industry. This singular action has removed fear of reporting safety concerns, and removed potential for a perception of "intimidation" not to report.

A COMPREHENSIVE APPROACH

Although the Individual Development and Personal Accountability Policy is a major element of the New Compact, many other initiatives also are helping establish the New Compact all across the railroad. Here are a few of many examples:

- *Labor/Management Selection Panels* — In another first for the rail industry, CSXT is providing rail labor with a voice in the selection of employees for certain management promotions and positions, demonstrating the railroad's commitment to making labor organizations partners in business and safety decisions.

- *Quality of Work Life* — The CAT is studying innovative ways of addressing quality-of-life issues, such as manpower planning, excessive absenteeism, crew management, work-rest issues and days off.

- *Customer Service Improvement* — Craft employees are part of a culture-change team that has resulted in improved service for Tropicana North America, which ships fresh orange juice on CSXT from Florida to the Northeast and Midwest in unit trains.

- *Dress for Effectiveness* — CSXT has adopted a railroadwide policy of business casual dress. This "dress for effectiveness" policy is designed to reduce an image of autocratic management, encourage open communication, and eliminate visual barriers between managers and craft employees.

- *Operational Testing Program* — With participation from labor organizations and the FRA, CSXT has revised its operational testing program. The new program shifts emphasis from discipline to training and development with labor helping design the follow up.

A NEW RAILROAD FOR A NEW CENTURY

Preparing a company with cultural roots in the early 19th century for the 21st century is a formidable task — one that requires courage and commitment. CSXT, our employees and labor organizations are demonstrating that courage and commitment by embracing the New Compact. By reinventing our company's culture in a spirit of trust and teamwork, we are ensuring that our railroad will continue to be a major contributor to the American economy for many generations to come. And safety will be our cornerstone.

Voices of Change: What Some Are Saying About Us...

- *"Within the industry, CSX has forged ahead on the issue of empowering employees while other railroads have proceeded more cautiously. 'The language being used by CSX and other* *railroads is similar, but the difference is CSX is applying it,"* says James Brunkenhoefer, national legislative director for the United Transportation Union in Washington, D.C." The Wall Street Journal, Florida Journal, April 7, 1999.

- "*I've never seen anything like this in my 20 years*" with the railroad. Robert Cobb, Conductor and UTU local chairman, Montgomery, Ala. The Wall Street Journal, Florida Journal, April 7, 1999.

- "*The new policy is nonadversarial and allows employees to learn from their mistakes...rather than disciplining them and sending them home. Instead of being tailored to the 'problem' 1 or 2 percent, this policy is geared to the 98 or 99 percent who do a good job.*" Traffic World, November 2, 1998.

- "*There is risk in my calling for a New Compact. There is always risk when you paddle into unexplored waters. And I don't have the answer — the silver bullet that will end our long history of conflict. But I know that this is a unique period in which all parties are willing to take these risks. Let's not let this moment pass us by.*" Alvin R. "Pete" Carpenter, Vice Chairman, CSX, and former President and CEO, CSX Transportation, in a published message to employees.

- "*Today we begin writing the first words in a new book about how labor and management should work together on the railroad of the 21st century in a partnership of mutual respect and accountability. Every operating employee on CSXT literally begins his or her working life today with a fresh start at a carrier that is asking them to participate in creating the best working environment on an American railroad in history. This is an opportunity we intend to seize and turn into a success.*" Charles L. Little, International President, United Transportation Union, at a news conference announcing new discipline policy.

- "*SENSE provides information about safety issues and a flow-back mechanism to ensure that workers are kept informed about resolving those issues. From the enthusiasm that I've seen, there is genuine buy-in at all levels. Workers now have the ability to call attention to unsafe conditions, to inventory the property for unsafe conditions, and to have them fixed.*" Clarence Monin, former International President, Brotherhood of Locomotive Engineers, in CSXToday employee newspaper.

- "*The company is asking for and accepting my advice. Imagine that.*" Randy Hall, Engineer, Tampa, Fla., member of Tropicana service improvement team.

- "*This new policy will serve as the industry benchmark helping all of us achieve our collective goal of zero tolerance (for injuries). This policy is in keeping with the spirit of the partnership established among CSXT management, railroad labor and the FRA.*" Jolene M. Molitoris, administrator of the Federal Railroad Administration, at a news conference announcing new CSXT discipline policy.

CONCLUSION

The labor-management leadership team at CSXT recognizes that while we have a good start, we have a long way to go with our new compact to achieve our goals as a company. Those goals— zero casualties, premier customer service, company growth, and continually increasing franchise value to our shareholders, are within our reach if we do it together. We are committed to this course and believe it will be our competitive advantage in the 21st Century.

Paper delivered by James T. Schultz, VP and Chief Safety Officer, CSXT, October 21, 1999
Banff Springs, Alberta, Canada -- 1999 International Rail Safety Conference

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Paper 9916

Mabila Mathebula

Linking Employee Engagement to Safety Performance: A Human Assets Approach

Publisher
2000 International Rail Safety Conference

CURRICULUM VITAE SUMMARY

FOR

A.MABILA MATHEBULA

PERSONAL DETAILS:

Born in Soweto – 12 May 1963. Permanent Resident in the Republic of South Africa.

ACADEMIC DETAILS:

B.A. in Sociology and Education (Vista University) B.A. (Hons) in Sociology (UNISA). MBA (final year) with Midrand University.

CAREER PATH:

- ***Joined Pace Community College as a teacher from 1984 to 1993.***
- Lectured Sociology to UNISA students on part time basis from 1991 – 1993 (PATUSA).
- Left Pace Community College in 1993 to join SABC as a news producer.
- Joined Spoornet as a Communications Consultant (Assistant Manager) from 1995 to 16 October 1997.
- Joined Spoornet Service Planning as Manager (Rail, Risk and Quality) 16th October 1997 to date.

AVOCATIONS:

- Motivational Speaking.
- Writing.
- Reading.

SPOORNET

INTERNATIONAL RAILWAY SAFETY CONFERENCE 1999 (CANADA)

TOPIC: LINKING EMPLOYEE ENGAGEMENT TO SAFETY PERFORMANCE: A HUMAN ASSETS APPROACH

NAME: MABILA MATHEBULA
DESIGNATION: MANAGER (SAFETY REGULATIONS)

COMPANY: SPOORNET, SOUTH AFRICA

COUNTRY: THE REPUBLIC OF SOUTH AFRICA

SPOORNET

SUMMARY

This paper outlines an eight-step pyramid safety model for linking employee engagement to safety performance. It should be understood that the important goal of railway safety must be promoted by two different efforts: the reduction of accidents and the protection of life, property and the environment.

DEFINITION OF CONCEPTS:

(a) EMPLOYEE ENGAGEMENT

According to Kim and Mouborge (1998) Employee Engagement means involving individuals in decisions that affect them by both asking for their input and allowing them to refute the merits of one another's ideas and assumptions.

(b) THE HUMAN ASSETS APPROACH

It means explicitly teaching employees desired values and behaviours. It is about empowering people to act as the CEO would, and then rewarding them when they do. (Farkas et al. 1996).

(c) EMOTIONAL INTELLIGENCE

Emotional Intelligence refers to the capacity of recognising our own feelings and those of others, to motivate ourselves, and to manage emotions well in our relationships. (Goleman, 1998).

(d) SAFETY

According to Bird (1996) safety is defined as control of accidental loss.

INTRODUCTION

In this paper we share an eight-step pyramid model that can be used by organisational leaders to improve safety in their organisations. We describe the components of each step and how to manage the process. This model is flexible and concrete. Checklists are provided for easy application and adaptation. (See Appendix A).

BACKGROUND

The democratisation of South Africa in 1994 had a major impact on many organisations and Spoornet is no exception. Managers are angry. Employees disenchanted. Turnover is high. Morale is low. Accidents have escalated to levels unimaginable. Leaders are frustrated. Management had to deal with three change - resistant personalities.

" Any successful organisation has three change resistant personalities" writes Friedman. "You have Barons who perceive change as risk to their fiefdoms and personal importance. You have Creationist who feels comfortable with things as they are and distrust evolution. And you have Romantics, who hark back to some imagined Camelot, when every subject in the kingdom was prosperous"

Following two years of research, we developed an "eight-step pyramid safety model" that we have successfully implemented in our organisation.

THE RESEARCH FRAMEWORK

We conducted a qualitative research study on the best methods and practices for engaging employees to safety performance in an ever-changing environment. Using a formal and verbal survey format, we interviewed and studied over five change efforts in our company. We also conducted an in depth analysis on leadership.

We used a human assets approach. Simply put, this approach means that safety is managed for success through people policies, programs and principles (Farkas, 1998). It means that people are to be more precise, employees are taught desired values and behaviours. The philosophy behind this approach is: Give a little responsibility; get a little back, but give a lot, and people soar. It's management by letting go. Live and let live.

There are a lot of companies which attempt to motivate people by paying them a lot. I don't dismiss this method's efficiency, but people are likewise motivated when they enjoy coming to work, when they like the people they work with, and when they are a part of a caring environment with a sense of belonging and ownership.

Keeping people happy and caring about them has another positive impact on the organisation, it creates "synergy" between divisions, the kind of co-operation that gets people to talk, share information, and hold hands in times of trials.

In companies without integrity as a core value, politics and manipulation thrive and creativity evaporates. It is important to know the human beings behind "human asset management". We must not only be interested in careers but in families, personal problems and personal interests. The more you know people the more you can help people achieve the happiness and motivation that keep the circle alive.

The human assets management approach comes down to trust development and empowerment. It is a system that disseminates certain, explicit values and then rewards those who embrace them, building an organisation in which everyone demonstrates predictable, acceptable behaviour (Farkas, 1995).

In many organisations safety is in "neutral zone." A neutral zone is a nowhere between two somewheres. The eight-step safety model outlines eight successful factors that must be co-ordinated, balanced and tracked in any safety change effort.

The model pays attention to change. Change is hard. It often requires groups and individuals to abandon the experiences, beliefs, and values that have guided their careers for many years.

Research had shown that discipline collapse is always a problem in any changing society. This was a serious "disease" that warranted our attention. The causes of discipline collapse were the following: rebellion, anger, the pain of divestiture, incompetence, resistance, poorly defined regulations and disengagement. Disengagement is a cause for concern because without employee engagement safety performance will suffer and therefore perish.

There are many change theories; the most classic being Kurt Lewin's unfreezing, moving, refreezing (Cummings and Worley, 1993: PP 27). The human assets approach by Farkas et al (1996) was found to be appropriate in our research. This approach promotes an environment of honesty in which people feel confident and trust one another. This environment promotes risk-taking problem – solving and creativity, which results in employees who work hard and stay with the company for a long time. These employees, experienced and motivated, naturally improve the company's operations, and create success. Success leads to happiness, which leads back to integrity and safety performance.

THE PYRAMID SAFETY MODEL

The pyramid Safety Model consists of eight steps:

1. Enact the role of safety leadership
2. Active participation by organised labour
3. Nurture safety teamwork
4. Develop training and communication system
5. Safety counselling
6. Intellectual and emotional recognition
7. Develop a reward system that would pay for safety performance and safety results and,
8. Like a reverse gear, measure and monitor how the system works.

These steps are meant to engage your employees. To get the safety wheels in motion, all the eight "gears" must be fully engaged.

1. SAFETY LEADERSHIP BY TOP MANAGEMENT

If you want to accomplish anything effective, start at the top. As Rose Harrington aptly put it "You cannot sweep the stairs by starting at the bottom and working your way up." Leadership is the skill that must be mastered if you want to play "above the safety hoop." There is an acute need for leadership in safety management. Leaders must demonstrate their commitment to safety. It is also important to develop safety leadership in middle management and supervisory levels. It is a truism that safety is over-managed by underled. Leading skills are different from managing skills. Managing involves planning, organising, controlling, and doing. Leading involves visioning, aligning, empowering others and constancy of purpose.

What kind of leader do we need in Safety Management? A philosopher called Isaiah Berlin talked of the difference between "hedgehogs and foxes" among human population. Hedgehogs move people around like pieces on the chessboard without taking into account the human consequences. Foxes take the individual needs of people into account. We definitely need safety "foxes" not safety "hedgehogs". We can only play above the safety hoop if and only if we have leaders with Emotional Intelligence, (Sunter, 1999).

Research and practice show that there are five activities that leaders must engage in. (Neuschel, 1998)

❖ SHOW THE WAY

The leader must be involved in shaping and articulating the safety mission of the organisation. He must articulate it clearly and convincingly and inspiringly, identify the ongoing tasks necessary to achieve the mission, and discipline the organisation to always concentrate on those tasks (Neuschel, 1998).

Leaders from that safety cannot be assumed but must be displayed. They must be safety torchbearers and the protectors of the flame should its brightness be endangered

- **MOTIVATING THE ORGANISATION**

The leader must generate excitement "turn people on." He must generate passion. As Tom Peters warned "programs fail because of systems without passion or passion without systems." One may, safely say those safety programs fall because of leaders without passion.

- **BEING THE AMBASSADOR**

The leader must represent his people and must be beyond blemish. He must bring joy and pride to his people. The leader speaks for the troops. When things go wrong he must take collective responsibility.

- **COPING WITH THE STRATEGIC**

He needs to be conceptual and imaginative, coupling his vision with actions and pragmatism. Develop strategic goals, which incorporate safety goals and objectives.

- **DEVELOPING NEW LEADERS**

He must ensure that people are coached. He must provide them with resources to do the work. Measuring results by giving feedback. People appreciate two things: positive feedback (a pat on the shoulder). Secondly, negative feedback with guidance. The worst thing you can do to an individual is to refuse him feedback.

David Goode, Chief executive Officer of Norfolk Southern Corporation believes that six leadership characteristics have been most critical in his own career.

1. Generating loyalty in one's followers.
2. Making a total commitment to the company.
3. Being, and being perceived to be, completely fair.
4. Demonstrating great trust in your managers.
5. Developing an in-depth understanding of the business and the capacity to use that knowledge and experience in making the right choices.
6. Emphasizing that it is important never to be a "phony."

SPOORNET

2. ACTIVE PARTICIPATION BY ORGANISED LABOUR

Social responsibility goals are increasingly becoming important. Health and Safety have emerged as important goals for many organisations. Today, corporate citizenship is a mainstream corporate issue that has permeated the boardroom and the shop floor.

Spoornet is a highly unionised environment, so before management embarks on any major program organised labour must be on board. The buy in of trade unions is very important in safety management.

Workers perceive management initiative in a negative light. Employees are always afraid of losing their jobs, so any management initiative is linked to job loses. Organised Labour is an important stakeholder in any company initiative.

If there is any discord between labour and management safety would suffer. As Nyerere once put it "When two elephants fight the grass suffers". Management and labour must work together for the collective good of safety.

The safety pyramid will collapse if organised labour is not involved in safety. In other words organised labour is a pivot on which everything rotates.

3. TEAMWORK FOR SAFETY

"None of us are as smart as all of us" - Japanese proverb. The days of "silos" or functional groups doing their own thing with a few managers trying to coerce some co-ordinators are gone. It is ongoing, face to face, spirited teamwork that propels safety, customer service and competitive advantage in the service sector. John Doer threw down the gauntlet with characteristic fervour: "In the world today there is plenty of technology, plenty of entrepreneurs, plenty of money, plenty of venture capital. What is in short supply are teams".

Spoornet has created co-operative team relationships throughout the organisation (The SHE Forum). The team model empowers individuals to create excellent relationships. If our attitude towards our colleagues is helpful, friendly and courteous, therefore, safety will improve and the company can project this image outside to the customer.

4. SAFETY COMMUNICATION AND TRAINING

Training and communication are essential for creating a safety environment. This encourages teamwork, and builds trust between employees and supervisors. Experience has taught us that in any changing environment rumour is the fast traveller. Good communication is good business. Good communication can help ease the pain of change. The most successful communication strategy include the following:

- A clear statement of commitment by top management
- A developed communication policy
- Milepost and successes are communicated regularly
- Mechanisms are in place to continually monitor the views and perceptions from the rest of the organisation (communication is NOT just downward)
- Stakeholder leaderships has (this includes management and organised labour) been contracted to do some safety communication
- The communication system should undergo regular evaluation to prove its worth.

At Spoornet we have found that it was impossible to expect employee to perform safety, if they were not excellently equipped or adequately trained. A number of organisations think that Safety Training is a waste of the company's financial resources. Training should be an ongoing process for all employees to keep up to date with all the day to day developments. If we want employees to solve safety problems on the spot without consulting their managers or supervisors, we need to train them. Managers and supervisors also need to be trained in order to effectively deal with employees themselves, their needs and expectations.

I have to sound a warning in good faith that the involvement of employees without education can be counterproductive. Open Book Management or Business Literacy is a vital tool. At Spoornet we have started ABET (Adult Basic Education and Training) to address this issue. If we want employees to think and act like owners, then we must treat our employees like owners. As we move toward the next millennium, companies that would adopt OBM (Open Book Management) would have a competitive advantage over those who are still conservative. Schuster (1998) urges companies to "..assume a fiduciary responsibility to its employees...".

Training is a very broad concept. There is technical training and Emotional Intelligence training. The former is easier compared to the latter.

Learning an emotional competence is a titanic labour. We must learn to approach people in a positive way instead of avoiding them, to listen better, to give feedback in a skillful manner. Goleman (1998) warned that one mistake "made by organisations is trying to instill an emotional competence like service orientation, using the same technique that effectively teach how to create a business plan". Goleman (1998) further drew a line of separation between Procedural Knowledge and Declarative Knowledge. Declarative Knowledge is about knowing a concept and its technical details whereas procedural knowledge is being able to put concepts and details into practice.

Emotional Intelligence training emphasises flexibility, integrity, and interpersonal skills. According to Goleman (1998) the following are the examples of Emotional competence training:

- Assess the job
- Assess the individual
- Make change self-directed
- Prevent relapses
- Deliver assessment with care
- Give performance feedback
- Encourage practice
- Arrange modules
- Arrange support
- Reinforce change
- Motivate
- Evaluate

5. SAFETY COUNSELLING

Our employees need support. In a number of organisations coaching takes priority over counselling. Any safety program must provide for personal counselling services. Recreational facilities and programs for off job hours.

This might seem like a money wasting exercise, but at the end of the day it pays some dividends. A large number of our employees are working under severe stress. For example, shift work employees miss out on a normal family life, so they need support in this area.

Some of the employees have seen their colleagues being involved in fatal accidents. This is a very traumatic experience indeed. Human beings are not machines they are affected by their surrounding. It is up to employers to build a safety hedge around their employees.

At Spoornet we have also witnessed the pain of divestiture. Many employees lost the power they previously had due to Affirmative Action. The only support Spoornet could give to all employees in this regard was an organised strategic diversity management program. Counselling like training should be an ongoing process.

6. INTELLECTUAL AND EMOTIONAL RECOGNITION

If we claim that people are our greatest assets, we must treat them with emotional and intellectual recognition in decision-making process. When people feel recognised for their intellectual and emotional worth, they demonstrate a willingness to act the new role demanded of them as safety employees.

If you want people to share their knowledge and expertise you have to make them realise that their knowledge and expertise are valued and worthwhile. People fundamentally do not accept but reject when others pay no respect to their intellectual worth. "Fair process make people feel treated with politeness and respect and hence makes then fill recognised as dignified human beings, it makes them **committed**" (Kima Mauborgne, 1998)

Schmidt and Finnigan offer the following seven principles for recognition and rewards (1992, p 255):

1. Place emphasis on success rather than failure
2. Deliver recognition in an open and publicised way
3. Deliver recognition in a personal and honest manner that is appropriate to the employee.
4. Tailor recognition and reward to the unique needs of the people involved.
5. Pay attention to timing
6. Strive for a clean, unambiguous, and well – communicated "line of sight" between achievement and reward.
7. Above all, recognize recognition, that is, recognize the people who recognize others for doing what is best for safety.

   Such as system encourages new behaviour and behaviours and includes a range of non-monetary recognition activities: coffee mugs, caps, T-shirts, Trophies, team recognition days, congratulatory notes, personal achievement, presentations, cash prizes safety lunches and dinners.

7. REWARD SYSTEM

We sometimes fall into the trap of rewarding people for good behaviour not for the right behaviour. We also reward people for performance not for the results. The fact is you may perform but still not produce desired results.

Ehrbar (1998) observed that many operating managers are gifted with great ingenuity, and all of them have an intense desire to succeed. How can we harness that ingenuity and degree and direct it in ways that maximise the success of both the individual and the enterprise as far as safety performance is concerned?

People do what you reward them for doing, not what you exhort them to do. Ehrbar (1998) argues "Base incentives on higher operating margins, and you will get higher operating margins. Pay people for safety, and you'll get safety. If you want higher margins, you must pay for higher margins. If you want safety, pay for safety.

The EVA bonus plan works very well. Simply put, EVA (Economic Value Added) is a measure of corporate performance that differs from most others by including a charge against profit for the cost of all the capital a company employs.

EVA bonuses make employees think like and act like owners. It is at the risk nature of variable pay that makes employees truly sensitive to shareholders needs. EVA is a tool that converts employees into value change agents. For example, an accident is a value destroyer and may lead into a negative EVA, which will eventually affect EVA bonuses. EVA rewards employees for results not only for performance.

8. MEASUREMENT

"Measurers should be selected to best represent all the factors that lead to improved customer, operational, and financial performance .. and to provide a clear basis for aligning all activities with the company's goals" 1998 Malcolm Baldrige National Quality Award criteria for performance Excellence.

It is said that "that which is measured gets done". It is impossible to manage what you cannot measure. Management without measurement is like playing tennis with the net down. Measurement is there to lift up the safety net.

Measurement ensures continuous empowerment. The emphasis should be placed on process control rather than inspection at the end.

The following tools can be used in measurement:

- employee surveys
- problem solving
- the frequency rate
- team process
- the severity rate
- check lists
- flowcharts
- pareto charts
- statistical tools
- cause and effect diagram
- "mirror" Analysis - comparable measurers

Employees must be involved in developing measures by which they will monitor their performance.

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RESULTS

The culture of management concerning safety has changed. Top management have recently committed themselves to Responsible Care. It is now apparent that employee motivation, employee participation in decision-making and the recognition of employees served as an added benefit as far as safety is concerned. Safety is a marathon not a spirit. Leaders are currently being trained in Emotional Intelligence. Plans are underway to train every employee in Emotional Intelligence. In addition organised labour is also on board.

CONCLUSION

The aim of the study was to develop a picture of how to link employee engagement to safety performance and to provide input for strategic planning. The eight-step pyramid model works like the gears of a motor vehicle. When all the gears are fully engaged safety performance will be accelerated. It calls for Emotional Intelligence on the part of the leadership. It all calls for commitment on each and every employee.

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APPENDIX A

CHECKLIST

ISSUE	DONE	HELP	RATING
Safety Leadership:			
Organised Labour:			
Safety Teamwork:			
Safety Communication and Training:			
Safety Counselling:			
Intellectual and Emotion Recognition Monitoring:			
Reward systems:			

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STANDARD RATING (0 -10)

	TERM	RATINGS
1.	Unacceptable Performance	0-2
2.	Below Average	3-4
3.	Fair/Acceptable	5-6
4.	Above Average/Good	7-8
5.	Outstanding/Excellent	9-10

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Paper 9917

Ms Margaret Papst

Psychological Aspects of Rail Safety

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Margaret is qualified as an organisational and industrial psychologist, an educational psychologist and as a teacher. She has 25 years' experience as an eductionalist. For the past 12 years she has consulted to the senior management of Australian commerce and industry – the thrust of her work being to maximize the productivity of the workforce.

Margaret has 6 intensive years' experience consulting to the railways. Her work has primarily been with Operations – particularly the job of train control. The purpose has been to ascertain that this pivotal, 'cliff face' job should be carried out by those with the aptitude and training to maximize its effectiveness. More recently she has worked with Engineering – particularly on the issue of Worksite Protection. The purpose has been to take a deep, comprehensive look at the psychological functioning of the rail industry to ascertain why a marked increase in track-maintainer deaths has occurred and make recommendations for change.

Margaret's broader experience with safety has been in the mining and chemical industries. Her particular work has been : senior management safety responsibilities; recruitment for safety; and Emergency Response.

Margaret is a member of the Australian Department of Transport's panel of investigators.

International Rail Safety Conference
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21 October 1999

Psychological Aspects of Rail Safety

Margaret Papst

<u>Psychological Aspects of Rail Safety</u>

All production environments of industry are fraught with danger.

The environment created by the operation and maintenance of a railway is possibly the most dangerous of all. The product (a train) is out in the open, continually moving, incapable of instant response and totally uncompromising It is invincible - shows no mercy.

A railway is operated and maintained by human beings - 'pieces of machinery' who are unique entities, dynamic objects in a constant state of flux. All have their own individual perceptions of a train. Some view it with indifference, some view it with horror, some feel a positive affinity with it - they love it.

A train and a human being, then, are a marked mismatch in functioning. Yet, the operation and maintenance of a railway requires that they constantly interact with each other Thus friction occurs and a very dangerous physical and psychological environment results.

Within this working relationship human beings build the trains, control their movement and maintain the tracks on which they run. Human beings are both the instigators and the receivers in the working relationship. When carrying out these two roles they need to be constantly aware of the merciless nature of a train and of human vulnerability in relation to it. Implicit in every thought and every action taken needs to be the passion to preserve the lives of those who work and travel on the railways.

SAFETY must be the cornerstone of a railway's purpose - the fundamental foundation of its function. It must underpin every aspect of the environment - both physical and psychological - in which a railway's operation is carried out. It must be intrinsic in the thinking and behaviour of all who work in that environment.

<u>Psychological Aspects of Rail Safety</u>

In the current economic climate, the primacy of safety is being very seriously challenged by misguided quests for economic success. Unfortunately, the drive for efficiency, and ultimately economic success, is often being interpreted as simply cutting workforce numbers rather than improving work practices.

True 'efficiency' is maximising the productivity of the workforce. It is finding the right people in the right numbers using the right work practices in the right frame of mind to deliver the best product. Only this form of efficiency will result in long-term, sustainable, economic success. And, it will only be achieved in any form of industry if it is grounded in SAFETY.

People determine SAFETY. They create and maintain both the physical and psychological aspects of the working environment. They carry out the operation of the organisation. Every single person contributing to the function of the organisation has a vital part to play in determining whether the operation and its surrounding environment is a safe one. It is the nuances and subtleties of the moment-by-moment thinking and behaviour of every player which set the ground rules for and ultimately elicit a safe operation.

The management team is responsible for setting the parameters, designing the infrastructure and developing, monitoring and maintaining the overall function of the organisation. It is vital that every member of the team keeps SAFETY at the core of every decision made and every action taken. Each needs to constantly work at ensuring that the perceptions on which his/her thoughts and actions are based are clear and practical - in touch with the realities of the operating environment. Each needs to get out 'in the field' very regularly, 'stand in the shoes' of the operator/engineer and <u>listen</u> to the workforce. Each needs to address how he functions within himself and clarify the personal value he places on human life - being constantly aware that his own standards will be implicit in his management of the workforce. Collectively, the management team sets the example for the organisation's thinking and behaviour.

Psychological Aspects of Rail Safety

If the organisation has clear, simple parameters and goals, members of the management team are emotionally mature, responsible, objective, logical, systematic and thorough within themselves and positive, constructive and communicative in their style, then the organisation will have the predisposition to be a safe one. The workforce will feel valued and be actively involved - and ultimately take ownership of their own safety.

Responsibility for the day-to-day activity on the track lies with the operators. The presence of certain characteristics in their thinking and behaviour can make a significant difference to their own safety and that of their fellows. These characteristics are: vigilance; focus; systematisation; thoroughness - with an eye for detail; a desire and the capacity to get things right exactly; clear, rigorous communication; spatial skills; problem- solving skills; - overall, the adoption of a very professional approach. They need to be able to take pride in a job well done

Responsibility for the building and maintenance of the track lies with the engineering staff and contractors. Again, the presence of certain characteristics in their thinking and behaviour can make a significant difference to their own safety and that of their fellows. These characteristics are: vigilance; clear awareness of the total working environment; the desire and capacity to follow the rules; team work; the desire and capacity to get things right; responsibility for self. Again, they need to be able to take pride in a job well done.

For a safe operation on a safe track both operators and engineers need to respect, to value and to listen to each other - acknowledging that the railway needs both parties in order to exist. From an overall organisational viewpoint, all the members of these two groups need to be ready to contribute and to change - if a safe railway is to be run in the current economic climate.

Psychological Aspects of Rail Safety

Every member of the railway workforce - whether working at the 'cliff-face' or 'behind the scenes' - influences the quality of the organisational environment and thus determines the place of safety in it. Members of the workforce who are stable, mature, realistic (don't make assumptions), confident in their self-knowledge, respect and value themselves, take responsibility for themselves, who are disciplined, think with exactitude, have awareness of what they don't know and accept the parameters of their own expertise, who respect their fellows, listen to them and communicate with them, and, above all, highly value human life and have an unswerving commitment to its preservation - these people will build a safe operation functioning in a safe environment. People whose thoughts and actions do not reflect these qualities will stunt the growth of safety or, even worse, destroy it.

The overall aim of the organisation regarding safety should be that every member of the workforce be actively involved in its promotion, take ownership of it for the organisation - and ultimately take ownership of it for themselves.

Two key starting points to introduce and promote the aforementioned qualities into the organisation are Selection and Training.

Areas which need addressing during selection are. job analysis and job specification; the search for sound raw material which is trainable; testing for intelligence, verbal and numerical skills, spatial skills, problem-solving skills; assessment of safety awareness and personality characteristics; interviewing.

Issues which need addressing during the formal induction stage of training are: delivery in the form of 'education' (not instruction); the active involvement of participants in the process; the presentation of material such that it can be synthesized and thus owned; the focus of content being on work behaviour; the level at which training is pitched being the lowest common denominator of its participants.

Issues which need addressing during the supervision stage of training are: there be a formal probationary period completed with certification; mentors be properly trained; they give clear, specific parameters; they understand modelling and are rigorous in their performance of it; and that all aspects of supervision be thorough and consistent in their practice.

Members of a workforce who are chosen for their aptitude for safety and comprehensively trained in its application will develop and maintain safe policies and practices for both the physical and psychological aspects of the environment in which they work. If the organisation is a good safety 'housekeeper' of this environment then incumbents and new employees together will build an even stronger organisation FOUNDED ON SAFETY.

VALUE + VIGILANCE = VICTORY FOR SAFETY

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Katsuya Chiba

Promotion of Spread of Union's Safety Philosophy

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Promotion of Spread of Union's Safety Philosophy

By Katsuya Chiba
Acting General Secretary,
East Japan Railway Workers' Union

1, Introduction

Since privatization of the former JNR and start of the new railway company, we, East Japan Railway Workers' Union (JREU), have aimed to establish a "Safety Philosophy" and spread it to our workplaces, cooperating with the management because we recognized that safety should be given a priority over any other things. A symbolic expression of our philosophy is "Do not pursue responsibilities but investigate the cause of accidents". Holding up our idea and standing by front-line workers at the workplace, we have campaigned to create workplaces in which workers can work more safely and discuss safety issues.

Twelve years has passed since the new JR started business, and it has been going better than was forecast at the beginning, and accidents have decreased steadily. However, despite the accident reduction, all workers at workplaces could not put our safety philosophy into practice or sometimes they misunderstood and behaved wrongly. As trade union leaders we had to insist on our policy and countermeasures to the management and at the same time we had to discuss with our union members to overcome the problems.

I would like to talk about my theme, "Promotion of spread of union's safety philosophy", giving two accident example cases.

2, To tell a lie cannot lead to investigation of causes

At 20:02 on 12 October 1997 at Otsuki Station on the Chuo line, which is in Yamanashi Prefecture, 90km north-west of Tokyo, a shunting electric train collided with an express train that was passing the station at the speed of 100 km/h. Lots of passengers were injured but miraculously, there was no loss of lives despite a very serious accident.

We were shocked by this unbelievable accident because we could not suppose that two signals of adjoining tracks, which crossed each other showed, "green" light at the same time. Even if a train driver operated wrongly, a train must be halted and installed and functioning safety facilities should prevent an accident.

We assumed only two causes: breakdown of safety facilities or a mistake by drivers.

The main cause of the collision was that the driver who operated the shunting train failed to see the "red" signal and what was worse, he had turned off the main switch of the Automatic Train Stop, ATS that would protect against driver's fault.

We recognized there were several background factors, for examples, driver-training system: its education contents, curriculum and duration and the working system at the workplace. We reviewed and discussed these factors in union meetings of all of our branches at workplaces.

However, for our investigation the biggest trouble was that the train driver involved in the accident had not reported that after turning off the main switch of the ATS he drove the train. Just after the accident it was turned on. As a result, we had to begin the investigation supposing the cause was breakdown of safety equipment or facilities. Much time was wasted and people were confused because of his false report.

We could understand his confused mind. It is natural for a human being after causing a serious accident; he trembled and he might think he intended to shirk his responsibility. Some of the leaders of JREU went to the accident site immediately and encouraged the trembling driver. We also told him to tell the truth first, then we could move to take further action to protect him.

Just after the accident he told us directly he turned off the switch of the ATS. However, when investigation began he insisted thoroughly that he had never turned off. We, as trade union leaders, talked with him and his parents for a long time. We persuaded them, "It is no use regretting to cause the accident. There might be your responsibility but tell the truth. Otherwise, we cannot take proper measures. We will do our best to protect you." However, he could not tell the truth to us.

We discussed this accident case at all our branches at workplaces to learn lessons. We recognized problems through the discussions: for examples, one of young members said that in his workplace there is not a good mood and circumstances such that when he felt unrest at his work he could consult one of his seniors or colleagues. Another said when he made a small mistake, we call it "Sogai", or obstruction, so in his work he could hardly report the real truth.

Talking about this from the union leaders' side, there was a problem in tackling accident-preventive measures or accidents themselves as well. This was exaggerated to say, we believed that to protect our union members involved in the accident meant not to ask about their responsibilities.

Since the start of the new JR business we had established a corporation culture on safety, "Do not pursue responsibilities but investigate the cause of accidents", as our philosophy. It was right, but without awareness we might mislead our members, saying "If you cause an accident the union prevents you from pursuing responsibilities". Therefore, some leaders of the union had acted wrongly.

In other words, to prevent accidents we should clear the facts and investigate causes, tell the truth on the accident, then we should propose proper preventive measures. However, we could not. We were asked our stance on tackling railway safety.

What was more, a bad atmosphere and circumstances ruled the union and management in workplaces; for examples, never tell the truth, do not report "sogai" or incidents, and say, "Let's forgive and forgive."

3, You cannot prevent fatal accidents as far as you take priority over only your work

At 0:14 on 21 February 1999, in the middle of Tokyo on the Yamanote Freight line, a tragic fatal accident to track-facility maintenance workers occurred. Five workers from a subcontracted company walking on the tracks were hit by a train coming behind them and were killed at once.

At the work site where the accident occurred there were neither any employees nor any supervisors from the JR East Company or contracted companies' that had a direct contract with the JR East Company. Victimized workers were from the second and third subcontracted companies. I would like to say "Really sorry", and to cry "Never again such a tragic accident".

There were several causes for this accident. One of the causes that led to the accident was that without completing established procedures, workers got into the tracks. Furthermore, before starting work they had not done a series of several agreed procedures.

This fatal accident to subcontracted track facility maintenance workers was caused by contracted companies directly but we thought we, a union, had responsibilities for their deaths because the maintenance work was ordered by the JR East Company and the accident occurred at a work site controlled by JR East Company. The subcontracted workers who were killed by the accident could have been our union members. From our point of view, "Safety issue takes precedence over any other matters", we started discussion with our management on preventive measures and brought the issue to our union members. One of my colleagues attending this conference reports details of this accident; so, I am telling briefly about what did we discuss in our organization.

After the occurrence of this accident we set up a "Joint Working Committee" with the management and discussed several times what the work on the tracks should be or how to improve it. As a result, we agreed that before everything, basically, we did not work on tracks with only a watcher's attention but did it after railway track closure, blocking trains from coming into the maintenance area to keep safety.

However, a typical voice from our union members at a work site was: " If we work by keeping above agreement, construction work will be overdue." Surely it will. Before the accident we worked on tracks relying on a train watcher's attention and using intervals between trains, but after the accident using track closure that takes time to follow the necessary procedures. We cannot work as smoothly as before. By this accident five were killed at once. Since the new JR started, in 12 years a total of 106 people had been killed by accidents. Facing such serious facts, we questioned our stance radically. Which you choose safety or work efficiency? We had to review how to protect workers' lives.

It is a contradiction that as leaders of the union we talk about safety in the union meetings but as foremen or employees in workplace we worry about delay to the work and give priority to work rather than keeping safety. We recognize that this problem is in our mind and should be overcome.

4, How JREU have reacted

JREU has a "Policy Forum" every November. This is a union conference. About 20 organizations qualified for the local competitions from sales, maintenance, train operation, office staff and other work sections present policies on working systems and safety measures. Contents of the Forum become better and better year by year and policies presented at the conference have a practical influence on the company. For our union movement it has become one of the important regular events.

In the Forum held in the year that the Otsuki Station accident occurred, which I mentioned in the second section, opinions and policies presented by representatives focused on this accident.

One of the representatives said that we insisted, "Do not pursue responsibilities but investigate causes of accidents, but we had to be clear that we were responsible for the accident when we caused it. Considering our responsibilities, we needed to discuss and investigate causes." He said that our struggle to investigate causes included individual responsibility. His suggestion showed us the way we should break through our contradiction barrier. We recognized that the union might speak to the company not to pursue responsibilities ... to reduce responsibilities. Therefore, we had not been able to do enough on investigation of accidents. The other representative said, "Union leaders should suggest that a member who committed accidents repeatedly should stop working as a driver and transfer to another proper job in the railway." This opinion also impressed participants.

We stood at a starting point to develop our discussion on safety at the Policy Forum in 1997.

Nevertheless, in one of train depots an incident occurred. While a maintenance worker was inspecting rolling stock marked by a sign, "Do Not Move Train", a driver started checking his train, tested electricity and moved the train for a short distance. Although fortunately, the maintenance worker was not hurt the union branch, which the maintenance worker belonged to regarded it as serious, informed its members about the incident and brought the issue to the other branch that the concerned driver belonged to. However, the driver's branch reacted; "There was no casualty and no delay of trains, so why has the maintenance branch enlarged the problem? Shut your mouth and no one will know. That's it. It is nonsense for a union to report its member."

Eventually, we agreed that if we ignored this incident the same one could occur again. It could be a fatal accident and might kill our colleague. We should pull the small accident buds off. So, we should be honest. Until we reached the conclusion, we had made every effort to discuss this seriously. At the same time it was a struggle against managers who did not want to break the status quo.

Talking about the fatal accident to maintenance workers which I mentioned in section three, we have been working to learn lessons. We had a meeting gathering union leaders from all maintenance workplaces last June. They have various opinions on the accident. Some of them were similar to the company's and the others were ones from pride of their craftsmanship that put priority on accurate work that sometimes ignored safety.

However, through the discussion we cleared our insistence: our basic stance is to protect our union member's lives. In other words, We become neither murderer nor the dead. We should abandon the consciousness that we always give precedence to given work, ignoring safety. As a result, if the work cannot be done on time this will be all right.

We of course will pursue the creation of safer circumstances. We do not hesitate to do essential work that is related to operational safety. First, we are creating safety measures with determination. In order to reform the policy we will even work to remove obstacles that may have accumulated through the long history of railway.

5, Conclusion: Without struggling we cannot establish a safety culture and environment

We are proud of our safety philosophy that has been created by union and management. Its symbolic words, "Do not pursuit responsibilities but investigate causes", are still right.

Although we, as human beings, sometime proceed back and forth, we should go back to our starting point and need to review. Keeping safety is an eternal problem for us to develop.

The words, "Do not pursue responsibilities, but investigate causes" are not only a motto for accident investigation, but also a warning of bureaucracy. It is said that an organization always becomes bureaucratic. In general, as an organization becomes bigger and bigger, the management intends to control workers without considering the situation of the people working in the bottom. The words of this philosophy have a meaning that is antithesis of bureaucracy as well.

We have been aiming for union and management to learn lessons from workers at the work site, and the company should put the lessons to practical use in safety measures. Top-down management cannot make a good corporate culture because that kind of management cannot take opinions from workers at the work site who have the wisdom to prevent accidents.

Our aim is to establish a corporate culture of "Safety First" in all our workplaces. We will been struggling for creating a safer railway system and happiness for our members and their families. I declare, "Keeping safety is an unyielding struggle."

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Tim Secord
Achille Ferrusi

Joint Initiatives in Health and Safety

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BIOGRAPHY—Achille Ferrusi

Born in Torre-dei Nolfi, Italy in 1950

Immigrated to Canada with parents in 1954

Obtained his Education in Canada completing his education with a Bachelor of Applied Science degree in Civil Engineering from the University of Waterloo in 1974.

Started work for CN in 1970 as a Student Engineer and after graduation worked on various Management and Senior Management positions in construction, engineering and operations until he assumed the position of Assistant Vice President Safety and Regulatory Affairs in June 1996.

Mr Ferrusi has been instrumental in involving Labor organizations in the Safety planning and programming process at CN as well as involving employees through Health and Safety Committee participation.

Since 1996 CN went from 4th safest railway in North America to the safest railway in North America based on Train accidents per million train miles using the US Federal Railway Administration(FRA) definition.

Joint Initiatives in Health & Safety

- *CN & UTU*
- *International Rail Safety Conference*
- *Banff, Alberta*
- *Tim Secord--UTU*
- *Achille Ferrusi--CN*

Legal Implications

- *By Canadian law a committee must be established in any work location with more than 20 employees, locations with less than 20 employees must have a safety representative selected by the scheduled employees.*
- *By law a committee must meet once per month and file an annual report with Human Resources Development Canada(HRDC) on these meetings*
- *The committee must be made up of management and scheduled employees*
- *The scheduled members are selected by Trade Union or by the employees where no union exists*

Legal Implications(cont'd)

- *A Quorum is achieved when at least one management and one scheduled employee appear for the meeting*
- *There is no requirement for equal representation from Management and Scheduled ranks*
- *The committee is mandated to review and discuss personal injury accidents/incidents and safety issues, concerns and hazards involving the employees they represent and make recommendations on these issues*
- *The Company is not obligated to adopt any recommendations made by the committee*

Legal Implications(cont'd)

- *by law committees have the right to self determine training unless the company and the Trade Unions jointly agree on training content.*

Effectiveness

- *Depends on the members(personalities) and the preparedness of the members(knowledge, skills and training)*
- *Depends on the Corporate commitment to the contribution of Health & Safety committees*
- *Depends on the interest and commitment of the Management representatives on the individual committees.*
- *Depends on the level of relative empowerment bestowed on the committees.*
- *Depends on the make-up of the committee, size and it's terms of reference.*

Key Issues--CN & It's Unions

- ***Common Motivation***--*improve workplace*
- ***Common Objective***--*improve level of training and preparedness of committees*
- ***Contentious Issue***--*content of training materials*
- ***Contentious Issue***--*method of delivery of training*

Problems Overcome

- *Political Agendas*
- *Trust*
- *Focus*
- *Bias*
- *Personalities*
- *Ownership*
- *Management Right*

Calendar of Events

- ***Spring 1995***
- *CN Great Lakes District met with it's Trade Union representatives in an attempt to introduce internationally accepted training materials to the Unions for the Health & Safety Committees.*
- *Trade Unions strongly objected to the material and demanded that they participate as equal partners with CN in the development of training materials for the committees.*
- *CN agreed to explore a joint venture in training with it's Trade Unions.*

Calendar of Events(cont'd)

- **Summer 1996**
- *CN Great Lakes District met with it's Trade Unions to further the joint training initiative*
- *The AVP Safety attending the meeting agreed to sponsor the project as a system-wide corporate objective.*
- *The meeting defined the scope of the project and the processes to ensure success.*

Scope & Process

- ***Scope--****Develop an 8 course(module) core training program to be delivered to all Health &Safety Committee members and all Supervision.*
- ***Process--****Selected a Program Advisory Committee(PAC) to oversee all training material developed--final word on course content--PAC was made up of one member from each Trade Union and 3-4 CN Management representatives.*
- ***Process--****Agreed to employ an outside independent training development consultant to develop training materials to ensure non-bias materials.*

Calendar of Events(cont'd)

- ***Fall 1996 & 1997***
- *PAC met frequently to review training material developed by consultant--course completed one module at a time.*
- *PAC agreed on training delivery process and selected trainers--to the extent possible all training was to be delivered by Trade Union members.*
- *Training package received final corporate and trade union approval.*

Calendar of Events(cont'd)

- ***Winter 1998***
- *Trainers were prepared for course delivery.*
- ***Spring & Summer 1998***
- *Training was delivered to all H&S Committee members on CN*
- ***Summer 1999***
- *Training delivered to any outstanding and new committee members and to all Front Line Supervision*

Ongoing Initiatives

- ***Disability Management***--*develop a joint early return to work program with all the Trade Unions.*
- ***Health & Safety Agreement***--*develop a joint set of guidelines for handling of Health & Safety matters.*

International Rail Safety Conference

1999 BANFF

19 October - 22 October 1999
Banff Springs Hotel, Banff National Park, Alberta, Canada

Paper 9920

Francois Laporte
Achille Ferrusi

The Influence of human reliability in safety performance

Note: This paper formed the keynote discussion paper for Plenary Session "B". 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

BIOGRAPHY—*Achille Ferrusi*

Born in Torre-dei Nolfi, Italy in 1950

Immigrated to Canada with parents in 1954

Obtained his Education in Canada completing his education with a Bachelor of Applied Science degree in Civil Engineering from the University of Waterloo in 1974.

Started work for CN in 1970 as a Student Engineer and after graduation worked on various Management and Senior Management positions in construction, engineering and operations until he assumed the position of Assistant Vice President Safety and Regulatory Affairs in June 1996.

Mr Ferrusi has been instrumental in involving Labor organizations in the Safety planning and programming process at CN as well as involving employees through Health and Safety Committee participation.

Since 1996 CN went from 4th safest railway in North America to the safest railway in North America based on Train accidents per million train miles using the US Federal Railway Administration(FRA) definition.

The influence of human reliability in safety performance

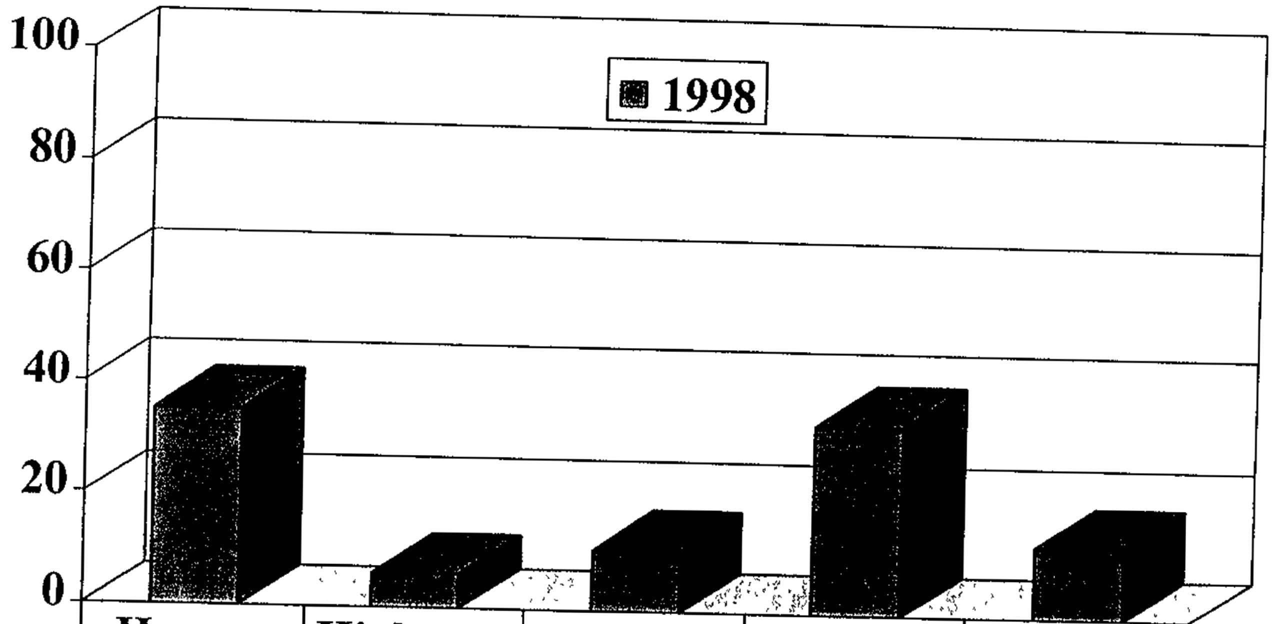
Prepared By:

François Laporte, Director – Safety management Systems
Achille Ferrusi, Assistant Vice-President - safety and regulatory affairs

Presentation objectives

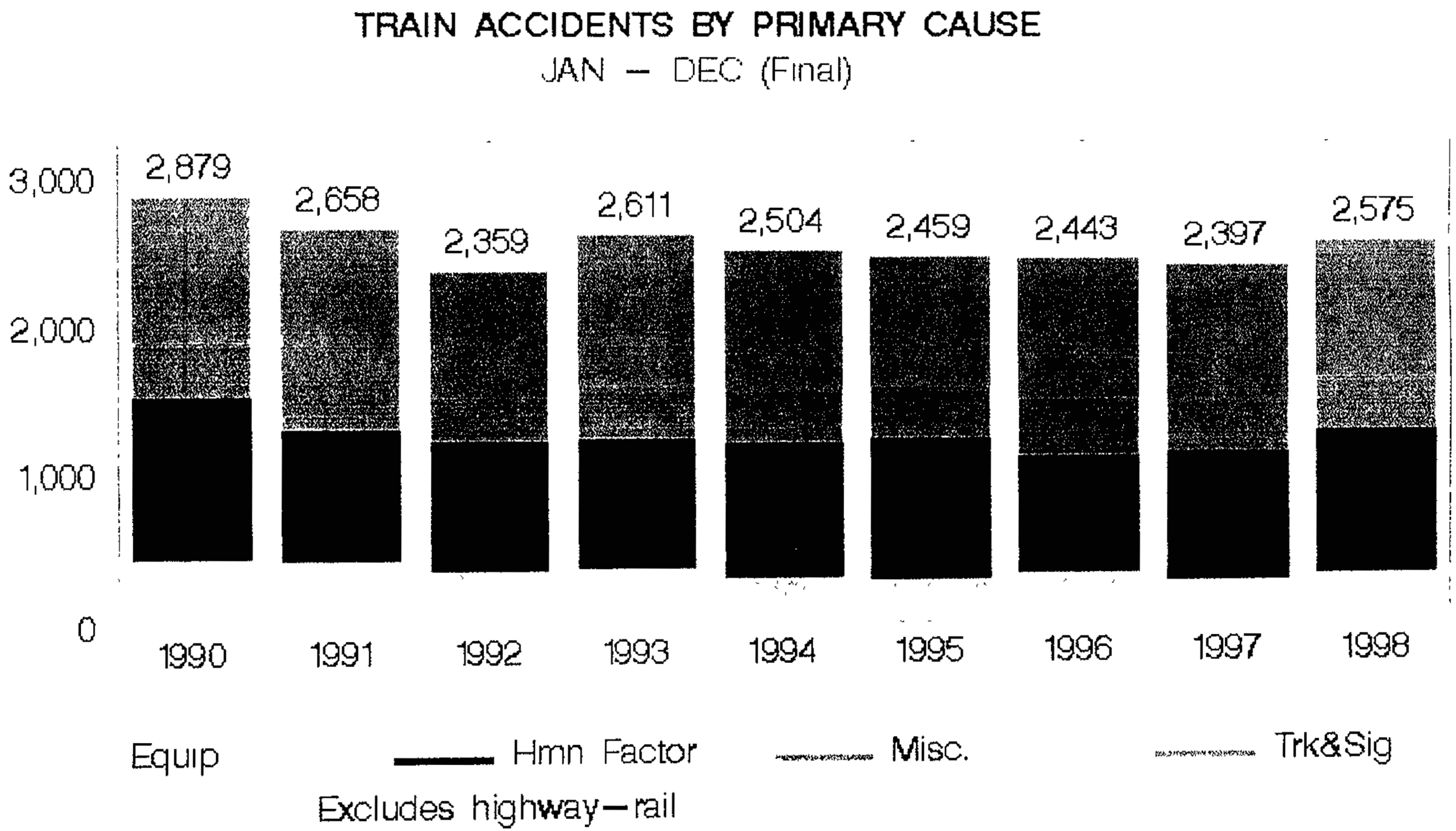
- Appreciate the relative importance of human reliability to Railway Operations
- Define human reliability and types of error
- Understand that accidents are the result most human errors in industrial situations
- Cite some of the characteristics of humans in work situation

Importance of human error to Railway Operation
FRA statistics 1998
(All Train Accidents)

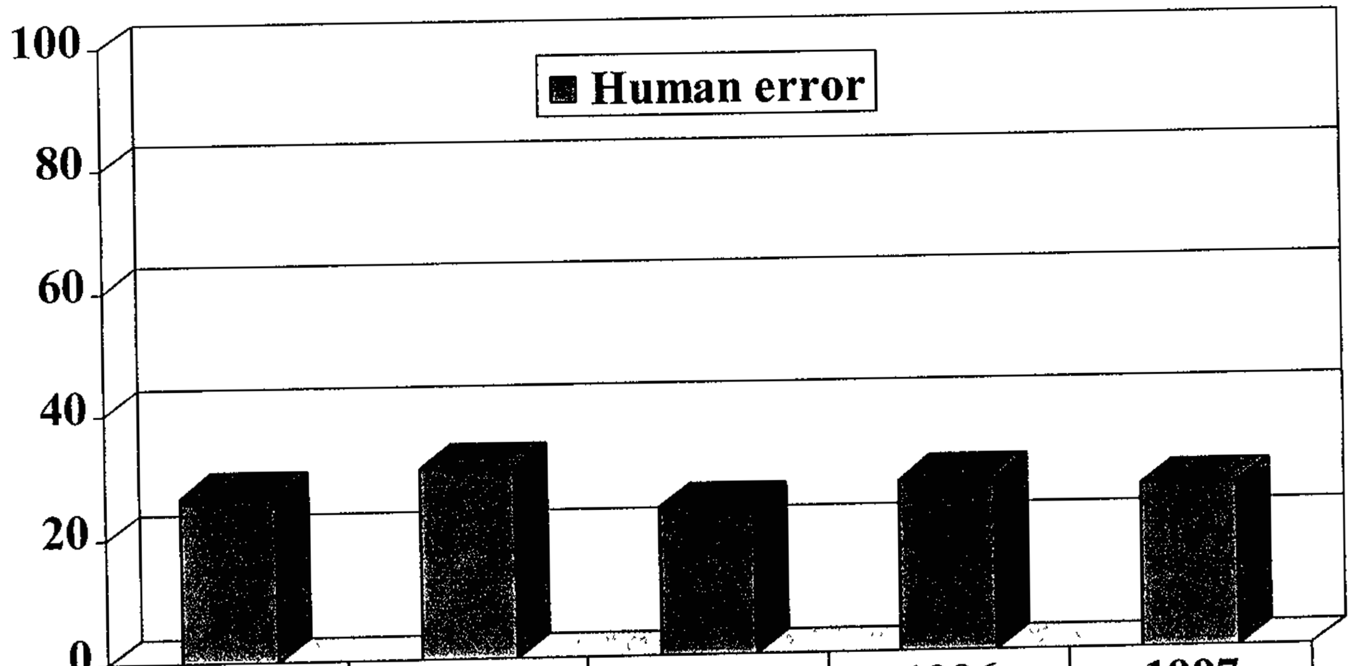


	Human Factor	Highway RAIL	EQUIPM ENT	TRACK/ SIGNAL	OTHER
1998	35.36	6.19	11.18	34.2	13.07

Importance of human factor FRA statistic



Importance of human error to Railway Operation
Transportation Safety Board of Canada Statistic



	1993	1994	1995	1996	1997
Human error	26.7	30.7	23.9	27.6	26.5

% of all derailments

Define human reliability and types of error

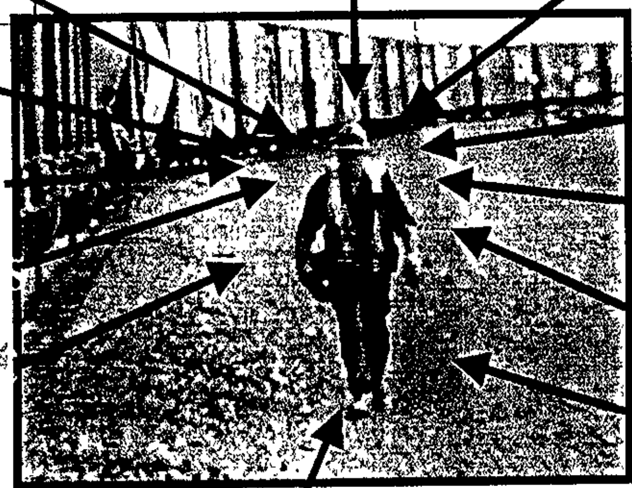
- Human reliability definition
  - The probability that an individual or group will adequately perform a given task and at the appropriate time
- Human error definition
  - Any error to to the human behaviour or response

Types of human error

- Human errors include:
  - **Intentional errors** – actions deliberately committed or omitted because a person believes, for whatever reason, that their actions are correct or that they will be better than the prescribed actions.
  - **Unintentional errors** – the error just happens;it was not intended
    - Unintentional vs. Intentional = mistake on a test vs. Driving over the speed limit
- Human errors exclude:
  - Malevolent behaviour – action intended to produce results that harm.

Performance Shaping Factor

- Any aspect of the individual and environment which predispose humans toward a certain performance level.



Performance shaping factor

- **Internal performance shaping factors**
  - Training/skill
  - Practice/experience
  - knowledge of required performance standard
  - Stress « mental or bodily tension »
  - Motivation/work attitude
  - Personality
  - Emotional state
  - Physical condition/health
  - Influences of family or other outside people or agencies
  - Group identifications
  - Culture

External Performance Shaping Factor

- Situational characteristics
  - Architectural features
  - Environment (temperature, humidity, vibration, etc.)
  - Work hours/work breaks
  - Shift rotation
  - Availability/adequacy of special equipment, tools and supplies
  - Organizational structure (authority, responsibility, communication, etc.)
  - Actions by supervisors, coworkers, union representatives, and regulatory personnel
  - Policies

- **Task, equipment and procedural characteristics**
  - Procedures (written or not written)
  - Written or oral communication
  - Cautions and warnings
  - Work methods/practices
  - Dynamic vs. Step by step activities
  - Team structure and communication
  - Perceptual requirements
  - physical requirements (speed, strength, etc.)
  - Hardware interface factors
  - Interpretation/decision-making
  - Task criticality
  - Frequency/repetitiveness

Stressor Performance Shaping Factor

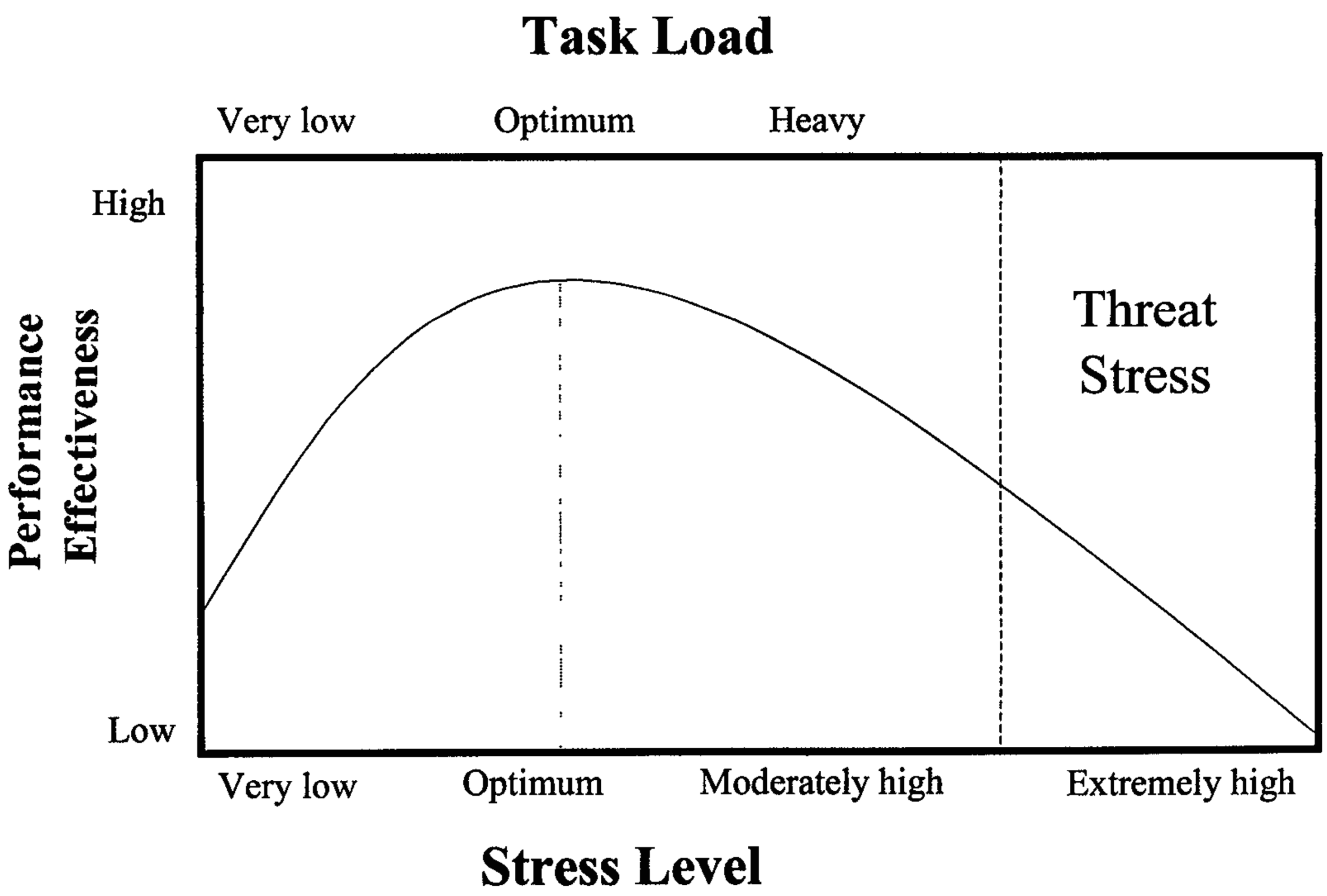
Psychological stressors

- Suddenness of onset
- High task speed
- Heavy task load
- High Jeopardy risk
- Threats
- Monotonous, degrading or meaningless work
- Long, uneventful vigilance periods
- Conflicting motives about job performance
- negative reinforcement
- Distraction
- Lack of rewards/recognition/benefits

Physiological stressors

- Long duration of stress
- Fatigue
- Pain or discomfort
- Hunger or thirst
- Temperature extremes
- Radiation
- Oxygen deficiency
- Chemical exposure
- Vibration
- Movement constriction
- Movement repetition
- Lack physical exercise
- Disruption of circadian rhythm

Relationship of stress and performance



Strategies for improving human performance

- **Two basic types of error we must address:**
  - Errors whose primary causal factors are individual human factors unrelated to the work situation
    - 15 to 20 % of human errors
  - Errors whose primary causal factors are related to the design of the work situation
    - 80 to 85% of human errors

Elements of the work situation approach

- Implementing human factors engineering (Ergonomic)
- Providing job relevant training and practices
- Providing clear, accurate procedures, instructions and other job aids
- **Providing ways to detect and correct human errors before undesired consequence occur**
- **Providing avenues for workers to achieve their social and psychological needs**

- To maximize the benefits of such strategy, we should involve the union and the worker themselves at every opportunity. After all, it is the workers who can best identify factors that hinder their performance and who will enthusiastically support such strategy if they are not penalized for telling the truth.

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Paper 9921

David Edwards

Rail Safety Worker Training: Assessment and Compliance An Australian Perspective

Publisher
2000 International Rail Safety Conference

National Rail

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7 September 1999

CURRICULUM VITAE

DAVID EDWARDS: Cert Man, Dip HRM, JP, MAITD, MIAROO.

NATIONAL MANAGER SAFETY:
NATIONAL RAIL CORPORATION LIMITED

David has been National Manager Safety for National Rail since July 1995, with national responsibility for the company's rail safety accreditation and occupational health and safety in each Australian State and Territory. David also has responsibility for coordinating the company's safety management plans, system safety incident investigation, corporate railway safeworking policy, and for liaising with various rail safety regulators and track owners on the implementation of major operational and safety projects.

David has enjoyed 33 years of Australian rail industry experience in recent positions such as Manager Operations Safety with the New South Wales Department of Transport, and as Locomotive Operations Manager with the New South Wales State Rail Authority.

Prior to this, David held various positions such as Accreditation Manager, Curriculum Development Manager, and Manager Locomotive Driver Training with the NSW State Rail Authority. David has also had wide ranging experience in general train operations as a Locomotive Driver and Driver Trainer, and has gained many additional qualifications in other areas of rail operations, including rolling stock construction and maintenance.

David holds a Certificate in Business Management, and a Graduate Diploma in Human Resource Management from Macquarie University in Sydney.

David is a current member of the Standards Australia Rail Safety Management Committee, the Commonwealth Task Group on Accident Investigation, and the Commonwealth Industry Reference Group on rail industry standardisation.

David is also a Justice of the Peace, and a member of both the Australian Institute of Training and Development, and the International Association of Railway Operating Officers. He is married with three teenage children and is actively involved in local church, community and sporting activities.

1999 INTERNATIONAL RAIL SAFETY CONFERENCE

19 to 22 OCTOBER 1999

BANFF, ALBERTA, CANADA

We make every move count

National Rail

"RAIL SAFETY WORKER TRAINING, ASSESSMENT, AND COMPLIANCE"

AN AUSTRALIAN PERSPECTIVE

By David Edwards
National Manager Safety
National Rail Corporation Limited
AUSTRALIA

www.nationalrail.com.au

RAIL SAFETY WORKER TRAINING, ASSESSMENT, AND COMPLIANCE

AN AUSTRALIAN PERSPECTIVE

1. About National Rail

1.1 National Rail Corporation Limited was incorporated in 1991 and began operating commercial interstate rail freight operations in 1993. Its shareholders are the Australian Federal Government and the State Governments of New South Wales and Victoria.

1.2 National Rail's mission is to provide competitive, profitable and commercially sustainable rail freight transport services in the context of an Australian economy competing in the world market place.

1.3 An important element of the vision of National Rail also demands the development of a Company culture that is customer focused, quality driven and safety conscious. National Rail's long term commercial viability is reliant on achieving the Company vision.

1.4 National Rail is Australia's major interstate rail freight carrier providing a service to each Mainland State and Territory Capital City and major regional industrial centres

1.5 The Company provides such services over the Australian transcontinental rail network that utilises approximately 8,000 route kilometres of track, and operates approximately 350 freight train services per week (a map of the National Rail Australian network is attached in the presentation slide copy).

1.6 The Company is not a common carrier, and does not undertake direct passenger or commuter train services. However, the Company does provide a hook and pull service as a contractor (locomotives and crew) to two other accredited operators providing long haul interstate passenger train services. These services include the Indian Pacific, The Ghan, and the new Great South Pacific Orient Express.

1 7 National Rail undertakes this task with a multi skilled workforce of 1211 employees. The total number of employees are in two categories, 1081 under an Enterprise Agreement, and 130 under contract. The Company has a two union coverage (85%) of the workforce.

2. Cultural Change in Australian Rail Industry

2.1 The modern era of rail industry workplace learning in Australia continues to raise many new challenges that were unheard of five years ago. Whether it is advances in locomotive computer technology or the desire to introduce nationally consistent safeworking systems and technical standards, today's workplace requires a never ending cycle of learning and discovery.

2.2 With the commercialisation and now privatisation of the Australian rail industry, the break up of the former State Government owned rail monopolies has enabled the introduction of many new rail operators. This changed rail environment has introduced competition and brought long overdue challenge to all aspects of existing industry work practises.

2.3 New rail safety regulatory approaches that separate track ownership from rail safety regulation have seen the adoption of more rigorous and transparent approaches to safety. Safety management is now focused on risk analysis, strategic response, risk mitigation, and performance auditing.

3. Competency Standards Development

3.1 A key element of the Australian rail industry safety management focus is the training and development of safety critical staff. This aspect has been vital in transforming what was traditionally a knowledge based "off job" training culture to one of acceptance and implementation of competency based "on job" training.

3.2 The development of competency standards provides for the "***consistent application of skills and knowledge to workplace standards across a full range of conditions***". Competencies can be used as the basis for many rail safety worker training and assessment activities.

3.3 Competency standards were developed within National Rail following a Federal Government training policy initiative and union support. The competency standards provide multi-skilling, improved work practices, workplace training, basis for pay, competency based classification structure (built into Enterprise Agreement), and improved levels of safety.

4. Rail Safety Worker Training

4.1 National Rail has implemented a comprehensive competency based training and development system to support the skills development of all its rail safety workers

4.2 Competency training in National Rail is supported by an Enterprise Agreement and has a major focus on developing a range of core competencies across the organisation, and specific specialist competencies within the appropriate employment streams.

4.3 The emphasis is on the development of a team based culture and the application of skills and knowledge to defined performance standards to ensure a safe and productive workplace. Achievement of competencies allows employees to progress through the agreed career structures.

4.4 The training system for the development of rail safety worker competency in National Rail involves the following key elements:

Off job training:	Specifically designed National Rail program, or an external program designed by an appropriate network track owner such as the NSW Rail Access Corporation.
On job training:	Structured training in the workplace and supported by an on-the-job workbook. Also facilitated by a qualified on-the-job trainer such as a Locomotive Driver Trainer, qualified to Workplace Trainer Category 2 level, or equivalent.
Competency Application:	Practical application and practice in the workplace while under appropriate supervision, to develop competency over the full range workplace conditions.
Competency Assessment:	Conducted by National Rail trained workplace competency assessors, or in some cases such as safeworking re-certification and Driver route knowledge, approved assessors from other accredited owners and/or operators.

4.5 Once approved by the National Rail Training and Development Manager, National Rail training courses become readily available to all sites and depots and are conducted in accordance with the plans and priorities of line management and local work teams. Rail safety worker training is also provided in accordance with the requirements of the rail safety regulators and, in the case of safeworking, to the (minimum) content standard as provided by the various track network owners.

4.6 Training plans and schedules are developed at the local depot, terminal and regional levels according to the business and rail safety accreditation needs. Plans are also developed to deal with the skill requirements and career path plans of individual rail safety workers consistent with the National Rail employee enterprise agreement.

4.7 It is the responsibility of local line management to organise the conduct of training programs including the procurement of appropriate course facilitators and allocation of "on job" trainers.

5. Training Curricula Standardisation

5.1 The Training Course Resource Package provides a standard format for all National Rail training courses ensuring consistency in presentation and quality. The training course resource package contains.

5.1.1 Training and Development in National Rail

5.1.2 Course Information

5.1.3 Presentation Guide

5.1.4 Participants Handbook

5.1.5 On-the-job workbook

5.2 There is a defined process for the design and development of the National Rail Training Course Resource Package that includes the involvement of appropriate subject experts, advisers and stakeholders, and final "sign off" by the most senior manager with responsibility for the subject covered by the course.

6. Rail Safety Worker Training Assessment

6.1 The track network owners have traditionally controlled all rail safety worker training assessment in the Australian environment. This restrictive "off job" knowledge based assessment model consisted of "multi-choice" written question and answer methodology However, this process reduced the effectiveness of the learning and only assessed subject knowledge not safety worker competence.

6.2 National Rail, with the assistance and encouragement of the rail safety regulators in each State, has pioneered the development and implementation of true competency based "on job" rail safety worker training assessment in many safety critical subject areas.

6.3 This fundamental change from the traditional knowledge based systems of the past has enabled the rail operators to take control of and manage their own assessment of safety critical competencies, while maintaining adherence to the minimum technical standard content as established by the track network owner.

6.4 Rail safety worker assessment and responsibility within National Rail is divided into two key areas:

Training Assessment: To determine if employees have satisfactorily completed the requirements of the structured off-the-job training course and the requirements of the structured on-the-job training.

Competency assessment: To determine if employees have achieved the required levels of competence in the workplace.

6.5 The training assessment process in all courses, is the combined responsibility of both the qualified National Rail "off job" trainer and "on job" trainer in order to assess the satisfactory completion of the training requirements.

6.6 Training assessment tools used include exercises, written tests, demonstrations, projects and on job workbooks. Training assessment results are recorded in the employee Competency Achievement Record (CAR) book and are available to line management.

6.7 The competency assessment of employees to National Rail standards is the responsibility of the trained and qualified Workplace Assessor.

6.8 Employees request assessment when they have achieved the required levels of competence following an appropriate period of practical application in the workplace. Workplace Assessors must consult with all appropriate technical, specialist and personal advisers.

6.9 Specific assessment criteria are detailed in the appropriate assessor guides and Competency Achievement Record Books and the National Rail Human Resource Management System (HRMS). Assessment results are recorded in the employee Competency Achievement Record (CAR) book and at appropriate times the local Site Training Committees moderate assessments to ensure consistency and quality of the assessment. The training assessment results are also available to line management as required.

6.10 All training course assessment processes, criteria and tools are detailed within each Training Course Resource Package, and relate directly to the knowledge and skill components of the defined competencies and the specified learning outcomes for each training course.

6.11 National Rail has developed safety critical performance "Check Lists" for use by the workplace assessors "on job" when assessing the key safety competencies including but not restricted to the following:

6.11.1 Locomotive Driver: Train and locomotive Management.
Safeworking rules and procedures.
Route Knowledge.

6.11.2 Terminal Operator. Operation of load lifting equipment.
Train brake examination and fault fixing.
Shunting and marshalling.

7. Safety Compliance Audit

7.1 National Rail's approach to safety compliance audit is one of continuous quality improvement involving all levels of the company including employee based risk committees.

7.2 Compliance audits are necessary for National Rail to demonstrate evidence of thorough independent assessment and compliance to agreed standards including the Australian Standard AS 4292, Railway Safety Management, and Federal Occupational Health and Safety legislation.

7.3 In addition, evidence must be provided to demonstrate that appropriate management systems and procedures have been established to manage the Company's safety risks, and that these systems and procedures are being followed.

7.4 The compliance audits also provide the focus for continuous improvement, together with ensuring that the National Rail satisfies both its corporate due diligence requirements and statutory obligations.

7.5 Rail safety compliance audits are conducted using competent internal and external quality auditors. This process involves the use of Company employee based "Risk Committees" at local depot level, Company Safety and Risk Management professionals for a Company wide perspective, and third party external auditors for an annual independent audit review. The various levels of the audit process are as follows:

7.5.1 Local depot or terminal risk committee audits.

7.5.2 Regional based Company audits.

7.5.3 Corporate annual compliance audit.

7.5.4 Corporate process of unannounced safety spot audits.

7.5.5 External rail safety regulator annual compliance audit.

7.6 All compliance audit results regardless of level require the development and implementation of appropriate risk mitigation action plans to address any identified areas of non-compliance.

8. Rail Safety Worker Compliance

8.1 Within the management of general safety compliance audit (as discussed in section 7), rail safety worker compliance is monitored and maintained throughout the company at each level.

8.2 This process is aided through the use of employee safety critical performance "check lists" administered by competent workplace assessors following the initial acquisition of competencies or at regular intervals of competency recertification. Agreed action plans are developed and implemented with any rail safety worker that may be identified as needing remedial corrective action.

8.3 In relation to Locomotive Driver compliance, regular locomotive data logger downloads are also conducted to analyse and monitor performance against agreed route and operating standards.

8.4 All rail safety incidents and accidents are investigated through the company developed "System Safety Accident Investigation" (SSAI) process. This SSAI process is based upon the principle of "no fault no blame", and is a useful tool to monitor safety worker compliance across a range of activities following an incident.

8.5 However, the major factor in all aspects of National Rail's management of rail safety worker compliance is based upon employee "performance management" rather than the more traditional "discipline" approach adopted in generations of now disbanded Australian State Government owned rail authorities. National Rail does not have an employee discipline policy

8.6 Ultimately the success of rail safety workplace learning and compliance is not high technology, it is the level of trust, respect, and cooperation existing in an organisational safety and business environment. Without this, the many cycles of innovation, knowledge enhancement, and employee ownership and empowerment that have been stimulated will grind to a halt.

9. Conclusion

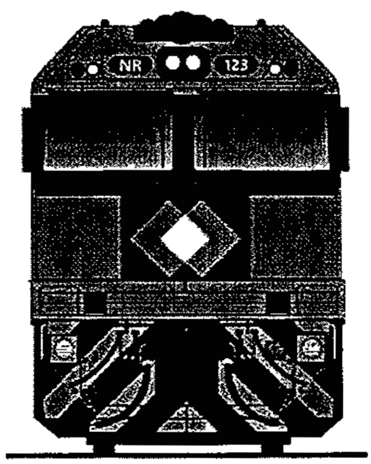
9.1 Since the disaggregation of the Australian rail industry in recent years, many gains have been made in standardisation and harmonisation of the industry. However, there remains much to be done to provide greater productivity, efficiency, and further reduction in the level of safety risk.

9.2 Figures released recently (27/7/99) by the Australasian Railway Association show that rail is by far the safest mode of transport in Australia. It is seven times safer than road transport and the annual cost of rail accidents to the community is just 1% of the total cost of road accidents.

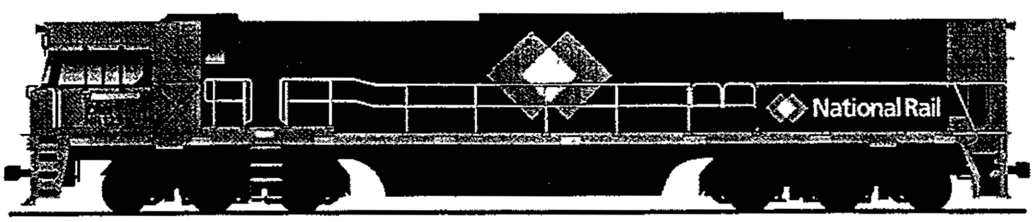
9.3 Rail safety worker training, assessment, and compliance are key elements in providing and maintaining a safe rail industry environment. To achieve this, organisations must be prepared to create safe workplace cultures that are more self sustaining and allow individuals to have more choice in how and when they learn, while also ensuring that agreed business priorities and expectations are met.

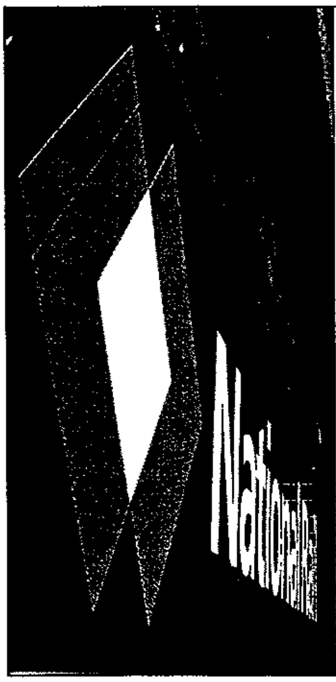
9.4 Part of the solution in meeting future safety needs is to realise that safety learning does much more than just satisfy bottom line outcomes, it most importantly, adds meaning and value to people's lives. If organisations can achieve this cultural change they will be better positioned to confront and manage the new, while dealing with the struggles of the past.

9.5 While there is always much more to be done, National Rail has achieved significant success in implementing a changed workplace culture in which safety comes before schedule.



Safety is National Rail's first priority





National Rail

Rail Safety Worker Training, Assessment, and Compliance

David Edwards
National Manager Safety

1999 International Rail Safety Conference
Banff Springs, Alberta, Canada
19-23 October 1999

About National Rail...

- Our company...
  - Established 1991, operational 1993
  - Shareholders are:
    - Australian Federal Government
    - NSW Government
    - Victorian Government
  - Elimination of annual rail freight operating loss of $320m
  - On track to privatisation

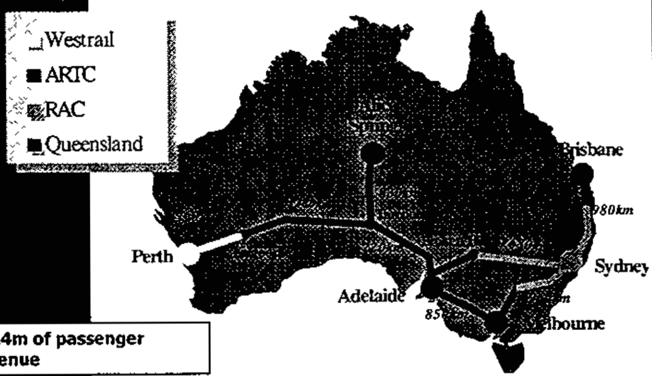
About National Rail...

- Our business...
  - Over 600,000 containers moved each year
  - SteelLink
  - Bulk
  - General freight/Express
  - Hook & pull passenger services
  - $480m annual revenue
  - Pay access to a national network

National Rail Corporation Ltd

The National Rail Network...

Haul $424.4* million and 15.5 billion ntk of freight over a publicly owned national rail highway (97/98)



*Excludes $13.4m of passenger and other revenue

National Rail Corporation Ltd

About National Rail...

- Our customers...

BHP	•BHP	(24%)
	•Toll	(14%)
F.C.L.	•FCL	(12%)
	•K&S	(7%)
PASMINCO	•Pasminco	(4%)
		61%

About National Rail...

- Our customers...
  - Product areas in:
    - Steel
    - Intermodal containers
    - Shipping containers
    - Industrial products (eg minerals)
    - Hook & Pull contract passenger services

About National Rail...

- Our workforce...
  - 1211 employees
  - 1081 under an Enterprise Agreement
  - 130 under contract
  - Two union coverage (85%) of workforce

National Rail Corporation Ltd

About National Rail...

- Our competitors...
  - Road transport
  - Coastal shipping
  - State Government rail operators
  - Private companies operating on rail - eg: TNT, SCT, Toll Transport

National Rail Corporation Ltd

Competency Standards Development

Competency -
the **consistent application** of **skills and knowledge** to **workplace standards** across a full **range of conditions.**

Competencies can be used as the basis for many **Rail Safety Worker Training and Assessment** activities.

National Rail Corporation Ltd

Competencies underpin National Rail's Classification Structure - as an example...

Level	Salary	Terminal Operators	Drivers	Controllers	Maintainers	Admin
9	194%					
8	185%			Senior OC		
7	160%	TO 7	Driver 7	Ops C'troller	Maintainer 7	AO 7
6	150%	TO 6	Driver 6			
5	140%		[illegible]			AO 5
4	135%	TO 4		Deployment Officer		
3	130%		Driver 3			
2.4	120%	TO 2.4	Driver 2.4		Maintainer 2.4	AO 2.4
2.3	113%	TO 2.3	[illegible]		Maintainer 2.3	AO 2.3
2.2	107%	TO 2.2	[illegible]		Maintainer 2.2	AO 2.2
2.1	100%	TO 2.1	Driver 2.1		Maintainer 2.1	AO 2.1
1.3	95%	TO 1.3	Driver 1.3		Maintainer 1.3	AO 1.3
1.2	90%	TO 1.2	Driver 1.2		Maintainer 1.2	AO 1.2
1.1	85%	TO 1.1	Driver 1.1		Maintainer 1.1	AO 1.1
Prelim	80%					

National Rail Corporation Ltd

Example: Driver 3

Driver 3 Competencies

Core Competencies

C3.4 Facilitate team problem solving
C3.5 Facilitate team communication

General Competencies

C4.0 Manage specific projects

Specialist Competencies

D3.0 Check and test locomotive control systems
D3.1 Perform locomotive brake valve tests
D3.2 Perform locomotive/train operations

Example: Driver 3

Specialist Competency D3.1
Perform locomotive brake valve tests

Elements of Competence

D3.1.1 Prepare locomotive for test
D3.1.2 Inspect & test locomotive brake valve operations

Performance Criteria (D3.1.1)

* Locomotive is secured as per NR procedures
* NR OH&S procedures, requirements and relevant regulations are identified and complied with prior to test

Evidence

Knowledge of locomotive brake systems etc
Ability to correctly interpret instructions etc

Competency Standards Development - why?

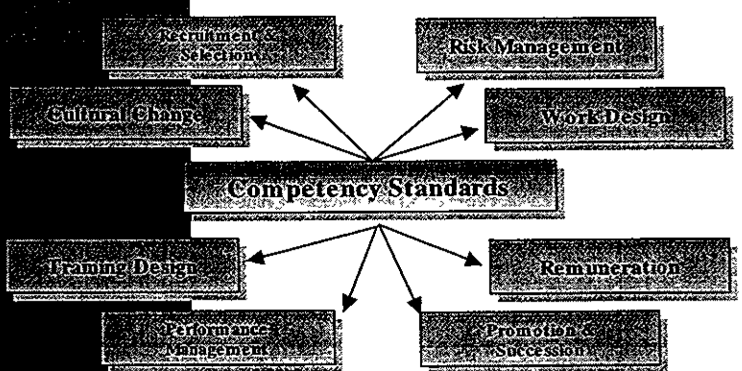
- **Driven originally by unions and Government training policy**
- **Multi-skilling and improved work practices**
- **Workforce training**
- **Basis for pay**
- **Competency-based classification structure is a key component of Enterprise *Agreement***
- **Improved safety**

National Rail

Competency Standards Development - how?

- Process Mapping (1993)
  - Functional analysis by taskforces (managers, operators, unions)
  - Competency standards developed for different operator groups
  - Competency standards incorporate quality principles
  - Validation process by consultants
  - Broad consultation
  - Incorporation into EA

Competency Standards Applications...



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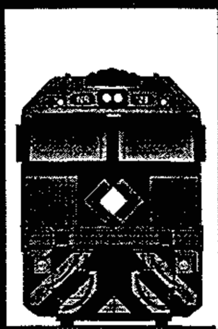


Competency Application - Recruitment & Selection

- Benefits
  - Targets precise selection criteria for the position
  - Promotes consistency and fairness
  - Consistent with behavioural based selection
- Problems
  - Can limit tailoring of criteria to specific situations

National Rail Corporation Ltd

Competency Application - Work Design

- Competencies are a means of formulating particular positions
- Position Descriptions can be written in competency format
- National portability of rail safety worker competencies achieved across State borders

Competency Application - Work Design

- **Benefits**
  - **Standards of performance built into work design**
  - **Clarity in role definitions**
- **Problems**
  - **If built into an employee's contract, changes may be problematic**

Competency Application

- Performance Management

- **Benefits**
  - **Consistency, fairness**
  - **Objective assessment of performance against prescribed standards**
  - **Incorporation of performance standards**
  - **Conducted on-job**
  - **Reduced safety risk**
  - **Lower costs**

Competency Application

- Performance Management

- EA employees assessed in the workplace by trained assessors as they achieve competency standards
- Contract staff assessed by managers or by peers and subordinates as part of the Performance Review
- 360 degree performance feedback systems can be based on competency standards

Competency Application - Remuneration

- Pay currently linked to competency attainment and application for EA employees
- Not linked to salary increases for contract staff (Management)

Competency Application - Remuneration

- Benefits
  - Pay related to competency not "grades" of paper qualifications
- Problems
  - Can promote a "training for training's sake" mentality

Competency Application - Cultural change

- Competency standards define behaviours required to achieve cultural change
- Promotes corporate values
- Provides a structured approach to managing safety worker compliance
- Promotes safety culture

Competency Application - Cultural Change

- **Benefits**
  - **Alignment of desired behaviours with corporate values**
  - **Consistency of required behaviours across the company**
  - **Integration of HR Systems**

- **Problems**
  - **Change in competency standards must be reflected in all HR Systems**

Competency Application - Training Design

- **Used for precise definition of the desired training outcomes**
- **Benefits**
  - **Efficiency in rail safety worker training and assessment design**

AUSTRALIAN TRAINING AWARDS

1997 Employer of the Year

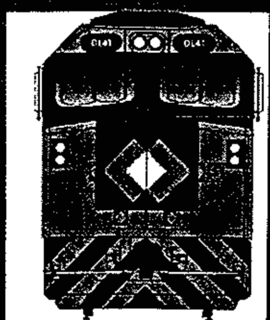
Competency Application
- Promotion & Succession Planning

- Can be used to identify job skills and corporate competencies needed to maintain competitive advantage

- **Benefits**
  - Improved planning and work design

- **Problems**
  - Focus must include qualitative judgements

Competency Application
- Risk Management



- Used for reducing risk exposure by improving safety performance in rail safety workers
- Benefits
  - Reduction in overall safety incidents
  - Highly skilled and competent workforce
  - Safety regulator compliance
- Problems
  - Maintaining focus on safety critical assessments

Competency Standards
- Future Directions:

- Simplification of standards documentation
- Building competency standards into the on-line HR systems
- Establishing consistency between EA and contract staff in performance management
- Base salary to be linked with technical competencies, bonuses linked to performance

Competency Standards - Issues

- Management understanding of the system at all levels is critical
- Management and employee involvement in developing competency and assessment standards
- Keep it simple - don't build a bureaucracy
- Remuneration for competency application and performance (targets / performance review)
- Safety critical

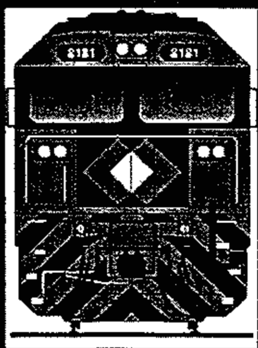
Competency Assessment

- Performance checklists:
  - Safety critical
  - Train management
  - Safeworking / route knowledge management
- Supervisor interviews
- Performance against locomotive data logger analysis (includes fuel usage)
- Safety incident reports

Safety Compliance

- Rail safety regulators
  - Annual top down safety audit
  - Safety inspections
  - Rail safety accident / incident investigations
- Track network owners
  - Safety inspections for compliance to agreed network standards

National Rail Corporation Ltd



Safety Compliance

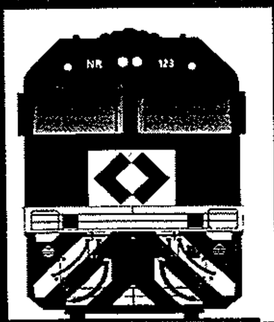
- National Rail internal process:
  - Competency assessment
  - Annual safety compliance audit (external)
  - Corporate spot safety inspections
  - Regional / depot audit process
  - System Safety Accident Investigation (SSAI)

National Rail Corporation Ltd

Safety Compliance

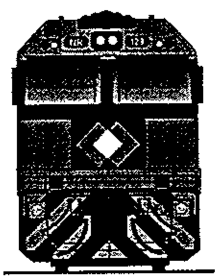
- Drug and Alcohol policies
  - Incident / accident alcohol breath test
  - Random breath tests
  - Random drug tests (outsourced)

Rail Safety Worker Training Outcomes:



- Competent safety workers
- Employee ownership
- Improved workplace culture
- Cost savings
- Improved safety
- Safety compliance

Safety is National Rail's First Priority



- A workplace culture in which safety comes before schedule

International Rail Safety Conference

1999 BANFF

19 October - 22 October 1999
Banff Springs Hotel, Banff National Park, Alberta, Canada

Paper 9922

Gary Housch

Railway Culture - Breaking the Mold

Publisher
2000 International Rail Safety Conference

Gary D. Housch - Biography

Gary D. 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 to work 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.

BMWE

Railway Culture
Breaking the Mold

Given by
Gary D. Housch
Vice President
Brotherhood of Maintenance of Way Employees

at the 1999 International Railway Safety Conference

Banff Springs Hotel, Banff National Park
October 19 - 22, 1999

Railway Culture - Breaking the Mold

The Railway industry in Canada - an industry founded on the vital mission of linking a nation from sea to sea. A culture that has transcended the challenges of time.

Throughout time, from the initial steps to the web-like spread across the nation, Railways have maintained that safety was important. However, the history books record the cost of human lives lost in constructing the first trans-continental railway in Canada.

Thousands of railway workers, suffered serious injury or lost their lives, building the "Canadian Dream".These were tragic losses of human lives, each with their dreams, desires, and love of life that we all share. Although this occurred long ago and many things have changed, some issues remain. As we move into a new century, we now have departments responsible not for safety and health, but rather for "Risk Management". What exactly is risk management? Does it not parallel some of the same safety concerns of the 1800's?

Risk management purports that all aspects of safety, including personal safety, have a cost associated. The costs of a lost time injury, the cost of a death, the cost of a derailment, these are all associated with risk management. Risk management allows us to relate the issues of worker accidents and fatalities as an economic figure on a balance sheet.

What makes risk management palatable?

The new "global economy", the invisible hand of the new market place, is the new "National Dream". This new market place concept is often used to explain away virtually all things that can go wrong with safety. It can water down our responsibilities for human life that we all share. In the past it was the need to build a transcontinental railway. In the present, perhaps it is more related to the health of the bottom line.

I submit that Corporations are minimizing the human side of safety, and if there were no economic costs to Corporations for injury and deaths, "exposed workers" would be the answer to the global economy and to maintaining our competitiveness.

So how do we regain the concept that human life is of the highest value? This "global economy" is a relatively new part of the culture, yet the concept is firmly entrenched in the current management of virtually every corporation in the world. Management spends too much time on the current quarter balance sheet and not enough time in areas that could enhance safety, both personal and operational.

Obviously, one answer to the question posed would be to ensure there are severe economic penalties associated with all accidents, especially personal injury and operational accidents. This will not likely happen. So I believe this agenda must be pushed by workers and their organizations Organized Labour must take a more aggressive role in putting the human side of personal injuries and operational deficiencies back to the forefront, back to making employers more accountable. We must ensure that such issues have a high profile, attracting resources and funding that support appropriate preventative actions. Also, we must use new and innovative ways to make senior management more accountable for injuries and especially workplace deaths. Never being one to miss an opportunity, I will take a minute to do so now. (slides)

Labour must work cooperatively to change the focus of the economics of the "Global Economy" back to human values. At every meeting I attend of our Union, there is a minute of silence to remember those that have paid the ultimate price for their jobs. How many executives in the Corporate Boardroom demonstrate a similar compassion for their employees?

Safety must also be a priority for unions at collective bargaining. One wonders why there would be opposition to this concept from any employers, yet we have experienced difficulty in this regard.

The industry has evolved over the years. Generation after generation of family working for the Railway. Father to son, and yes, it has been a primarily male dominated industry from its' inception. This is vitally important as the male ego has played a very important role in the culture I am attempting to describe.

The generation after generation of worker passing skills and knowledge from old to young has created a very insulated environment. Little, if any, outside education or training was done. Generally training in the industry was, and, to a great degree, continues to be done one on one on the job. Formal training if offered was developed and conducted "in house", each railway using their own employees to train other employees utilizing training packages that were also developed "in house".

Railway workers, at least in Canada, have maintained much pride in their work and a very strong "can do" attitude has existed in the industry for many years. To the workers, no challenge is too great and ways are always found to get the job done. This attitude is reasonable when one considers the conditions in the late 1800's and early 1900's. There was little or no communication ability, and limited outside resources available. Problems needed to be solved at the local level as much as possible. Even though technology has changed, the culture passed on from worker to worker has to a great degree survived and often flourished. One need only to observe what occurs at a derailment to see this "can do" attitude at its best. Obviously, this is an attitude that the industry has encouraged, perhaps subconsciously, but not surprisingly would wish to maintain. Unions in Canada, ours included, shake our heads in amazement that such an attitude exists in an industry that has gone through massive layoffs, affecting workers' quality of life, wages and working conditions. In my mind this shows how deeply rooted this culture is in the industry. The only explanation is that workers in the industry have a culture of facing challenges and they enjoy facing those challenges head on and with pride and determination.

Some of you, me included, think that this "can do" attitude is a good thing. In regards to safety however, it is, and I hate to use an economic term in regards to safety, but I shall, it is a liability. I have seen first hand how this "can do" attitude impacts on safety. Railway workers when facing challenges will innovate, create, and do whatever is necessary to meet those challenges. Unfortunately safety is often an afterthought.

For example, during a derailment when time pressures and long hours of service are the norm, we all know how things are done there. However, the culture requires the unspoken to remain so.

I recall my first days on the railway as a labourer on an extra gang. Like most rail workers I started there and learned on the job and moved through various classifications, with little formal training. There were 20 young men, yes all men, and one old foreman who I think was born on a motorcar. There was a derailment nearby and we were called to work there as we were the closest crew. A ballast car was lifted by a mobile crane, and we brought rails over to be placed under the car. Our mentor, teacher, and grief maker, the foreman told us to stand back while he went under the car, which was suspended in a sling at one end, and started putting spikes in the rail with a 4 pound hammer. He used a 4 lb. hammer as there was little room and to spike on the inside he had to lay between the rails. I noticed that when the crew responsible for the crane saw what he had planned their eyes glazed over, not noticing what was occurring, at least that's what they could say later. That crew took that opportunity for a break and left. It wasn't until later I realized why they were doing this. Well, let me tell you our gang had a hard time when there was a 60 year old man, climbing around under the car in dirt and creosote to drive spikes. So another part of the culture kicked in, the male ego, as well as a desire to help our older mentor, and we were all working under, in and around this suspended rail car. The foreman never objected, he had already told us to stand back, so he was covered, and understandably accepted the help with some relief. When we were finished and all out from under the car the foreman went to get the crane operator and crew, who were not part of our "gang" to lower that end of the car onto the repaired track.

So what was learned by 20 young railway workers, of which many went onto further jobs on the Railway?

.If you have a problem find a way to solve it with the tools and equipment you have
.If it looks safe and you think its safe go ahead and do it even if you know there is a risk.
.Other workers will help you "keep the silence" - if I didn't see it it didn't happen
.Derailments and emergencies may require you to throw the rules out the window to get the track open ASAP
.Experienced workers know what to do and how to do it - follow their lead.

At that time I had less than 60 days on the Railway. Today, there is no way you would have seen me under that car and I would have insisted no one go under it. The worst of it is, I know, as do many of you, that this type of thing happens fairly regularly. The code of silence however, prevents us from ever "really" knowing. This truly terrifies me. Even today, if I had not been out of the industry for 12 years I would still be doing such things. My attitude has only changed because I can now see this culture from the outside.

In my mind this "can do" attitude needs to be changed or controlled to ensure a safe workplace for both personal and operational safety. In Canada we have an opportunity that would have been inconceivable in our past. For the first time in railway history, at least in Canada and likely the US, a second generation of workers have had no opportunity for work on the railways. Our membership, like others in North America have an average age in the mid 40's and the majority of workers will be leaving in the next ten years or so. With this new workforce we have an opportunity to avoid the on job training which leads to some of the unfavourable aspects of the culture, and yet reinforce favourable aspects. Never before, and likely never again will we be given an opportunity to change the culture in the industry in positive ways. These new workers need to have training on safety, health, workplace conditions, and railway safety in a more formal and focused manner. This is not to say that inside industry training and development of educational packages by the industry is antiquated. Rather, I think that the people creating these programs need to be broad based and must include expertise from outside the industry.

When one speaks of culture, the ideas of community and family immediately come to mind. Workers in the railway industry, have worked together, grown up together, and until recently lived in the same community for many years. A natural result of this is a sense of community, but I would submit, it is even deeper than that. I believe a true sense of family exists even today in the industry. In many circumstances this sense of family transcends the traditional barriers of labour and management. Again, like the "can do" attitude this is a good thing. Yet it has far reaching impacts on safety. Family looks out for family and this is especially entrenched in the culture at least in Canada. Railway workers as a part of their culture will do many things to cover up for mistakes that may be made. This has been condoned and encouraged both tacitly and subliminally by workers in the industry. I would hazard a guess and state that this aspect of the culture even goes up the ladder in management. For example, I know of situations where operating rules have been violated but went unreported as there were no injuries and management could not find out about it in other ways. This underground non-reporting, I would suspect, is higher than most of us would care to imagine and there is but one way to find out. However, to do so we must remove yet another cultural barrier.

The last negative aspect of Railway culture that I have been able to think of is the discipline system. North American Railways, and I suspect other railways throughout the world, modeled themselves after the military, in both structure and organization. In the 1800's this made sense if you consider the labour relations environment at the time. Unfortunately, this militaristic management style also became part of the culture. While there are many in the industry who will say we have changed, I respectfully submit that you only think you have changed it, at least in North America. Rule and safety infractions mean discipline, nothing more nothing less. Notwithstanding the efforts of some railways in that regard, the idea of workers is still the same. Most railways in North America investigate operational errors in a very militaristic manner. Affected employees are called in for a "statement". They are sat down in an office and asked questions put forward by their supervisor. The questions and answers are recorded and the employee has an opportunity to say something generally at the end. Following the investigation discipline is assessed if the employee is found to be at fault by management. Such discipline can be and generally is grieved.

Rule and safety infractions are errors by the employee. Errors in judgment or performance. We need to accept the fact that we all make mistakes and will continue to do so. There must be a dramatic shift in the current attitude to worker error in the Railway Industry. A good start would be to adopt the principle that no worker should be disciplined for any reported safety infractions. We must start allowing workers to learn from their mistakes in ways other than discipline and the threat of job loss. Otherwise we encourage the continued non-reporting at every opportunity. How else can we really determine how safe this industry is?

The Railway industry has a culture of its own. A proud and determined group of workers make up this culture. However, it must be changed in order to enhance safety and this will not happen without concerted effort. Economics and the "Global Economy" is a force unlike any we have ever faced before, but so is human will. One wonders which will win out.

International Rail Safety Conference

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19 October - 22 October 1999
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Paper 9923

John Hall

Change the People or Change the People

Publisher
2000 International Rail Safety Conference

JOHN HALL, EXECUTIVE DIRECTOR, TRANSPORT SAFETY BUREAU
NEW SOUTH WALES DEPARTMENT OF TRANSPORT.

John is a mechanical engineer who trained and worked with resource company BHP for 27 years before joining the Transport Safety Bureau 6 months ago. During his time with BHP, John worked in many engineering, maintenance, contract management, operations management and safety management roles.

In 1993, when part of John's role was managing a steelworks railway, John became the first private owner/operator to be accredited under the then newly proclaimed NSW Rail Safety Act.

The Transport Safety Bureau has responsibilities for rail, bus, taxi and marine safety in New South Wales. Since his appointment, John has been leading the Bureau in a systematic, consultative approach to safety improvement with a strong focus on the wellbeing of people.

Change the people or change the people!

By John Hall
Executive Director
Transport Safety Bureau
NSW Department of Transport

Change the people or change the people!

- Perception of the need for change
  - Accepted long term work practices.
  - Perception that alternatives are better.
  - "Sins of the past."
  - Employee / union "right to work."
  - Change will create too many problems.

Change the people or change the people!

- Initial review of the situation and the people involved
  - External reviewer.
  - Comparison with road based transport.
  - Cost estimate of proposed changes.

Change the people or change the people!

- Demonstration of management commitment to change
  - Improve working conditions.
  - Listen to what operators have to say.
  - Be there when problems occur.
  - Stand by industrial relations decisions.
  - Plenty of discussion.

Change the people or change the people!

- Rewards and recognition
  - Celebrate achievements.
  - Involve families in recognition.
  - Letters of achievement.
  - "Thank you."
  - Display measures and targets openly and proudly.

Change the people or change the people!

- Establishing the climate for change
  - Facilitate!
  - Open, honest, consistent.
  - Discuss all options.
  - Concentrate on the +ve attitude employees.

Change the people or change the people!

- Establishing workplace standards and expectations
  - Review and reduce the number of rules.
  - Rules only rules when enforced, otherwise only advice.
  - Never walk past a problem or rule violation.
  - Commend adherence to rules.
  - Insist on high housekeeping standards.
  - Always speak in a positive manner.

Change the people or change the people!

- Establishing measures and achievable targets
  - Derailments.
  - LTIFR / MTIFR.
  - Charge out cost per hour.
  - Tasks lost to road due to unavailability.
  - Trend results regularly.

Change the people or change the people!

- The hard decisions, culling out the people who can't or won't comply
  - Must know who is with you and who is against.
  - Active culling of non-performers.
  - Build up factual cases against individuals.
  - Stand by dismissals.

Change the people or change the people!

- Changes to the Transport Safety Bureau
  - Rail, passenger and marine safety groups.
  - Focus on passengers and service delivery.
  - Systematic risk management approach.
  - Facilitate rail safety accreditation process.

Change the people or change the people!

- From management to leadership!
  - Rail safety systems auditing.
  - Rail safety accreditation.
  - No-blame incident investigation.
  - Industry advocate.

Change the people or change the people!

- **Conclusion**
  - Leadership is the key component.
  - The majority will meet expectations!
  - The good employees appreciate some culling.
  - Establish a vision and strive for it as a team.

International Rail Safety Conference

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Banff Springs Hotel, Banff National Park, Alberta, Canada

Paper 9924

Akira Ryokawa
Takashi Matsuda

Evaluation of safety activities and identification of future safety policies based on the questionnaire research to employees

Publisher
2000 International Rail Safety Conference

Akira Ryokawa's Personal History

Born on March 19, 1949 (50 years old)

EDUCATION

Iwate University. M.S. in Mechanical Engineering, March 1973

PROFESSIONAL EXPERIENCE

April 1973 – March 1987
Japanese National Railways

April 1987 – present
East Japan Railway Company

March 1988	General Manager, Transport Department, Takasaki Branch Office
April 1990	General Manager, Transport Department, Chiba Branch Office
June 1991	Manager of Passenger Service Div., Marketing Department
May 1992	Manager of Transport Div., Transport & Rolling Stock Department
June 1996	General Manager, Transport Department, Sendai Branch Office
June 1998	Vice-Director, Safety Research Laboratory

Takashi Matsuda's Personal History

Born on April 19, 1961 (38 years old)

EDUCATION

Waseda University, B.S. in Mechanical Engineering, March 1985

PROFESSIONAL EXPERIENCE

April 1985 – March 1987
Japanese National Railways

April 1987 – present
East Japan Railway Company

April 1987	Transport Safety Department
February 1989	Investment Planning Department
February 1992	Administration Div., Transport & Rolling Stock Department
February 1994	Transport Div., Transport Department, Tokyo Branch Office
February 1997	Deputy Manager of Ueno-Shinkansen Driver's Office
February 1999	Deputy Manager of Safety Research Laboratory

evaluation of safety activities And identification of future safety policies based on the questionnaire research to employees

October 1999

Akira Ryokawa, Takashi Matsuda

Safety Research Laboratory
East Japan Railway Company

I. Introduction

JR East has been making efforts to build safer railway systems and corporation culture in which employees themselves think about safety and try to achieve it.

The most important safety target in railway industry is 'no accidents causing fatalities of passengers and employees'. It has been unchanged from Japanese National Railways to JR East, but the approach to realize it has quite changed. In the time of the national company, only the top managers fixed safety plans and the front line employees were just expected to follow managers' instructions and act on rules. But now, we think it of great importance to trust and respect initiative of front line employees, who support railway safety, detecting and covering a flaw of the system, and to hold the policy to raise safety through reducing employee's mental and physical workload. In other words, the policy of overemphasis on discipline and rules and overestimation of the effect of hard punishment for accident causation have been completely replaced by the new principle that respect employees' initiative and motivation. This change gave the opportunity for employees' discovery that safety level would never be improved as long as the front line employees did not think and act by themselves, even if many rules were made. This recognition of each employee also improved safety attitude and work motivation.

"Challenge Safety Activities" (CS Activities) are the typical ones to realize the above principle, which started in 1988 with a slogan of "all employees' participation". These are aimed to reform our safety culture through front line employees' thinking, discussing, and taking actions for 'safety'. As a result, we think we have fairly succeeded in building the corporate culture in which members of our company from the top management to front line employees share the process to identify safety issues.

A policy with regard to capital investment has also changed. In the national company, equipment investment had to be weighted toward transport capacity reinforcement, modernization of the systems, and rationalization of the organization, with the result that the investment for safety, the effect of which was hard to find compared with its cost was apt to be put aside. This policy was, we can say, forced mainly due to the serious financial deficit of the company. After privatization, we think we should, and we can give high priority on safety investment.

The brief history of the safety projects is followed.

1988 Start *Challenge Safety Activities (CS Activities)* all at once in the company

1988 Start *General Inspection of Safety* (main contents are discussions with executives including our president and front line employees. We have 17th times this year.)

1989 Establish *Safety Research Laboratory* (main duties are research and development realizing safety as the total railway systems.)

1989 Establish *General Training Center* in every branch office (main purpose is the progress of employee's knowledge and skills.)

1989 Draw up a safety investment plan accounting for 200 billion yen in total over five years

1990 Hold *Railway Safety Symposium* and *International Railway Safety Conference*

1994 Draw up *Basic Safety Plan* over five years

1999 Draw up *Safety Plan 21* over five years (next version of *Basic Safety Plan*)

In this way we have continuously tried for progress of safety, placing it as the central matter of the management. As a result, the number of the accidents has drastically decreased from 376 in 1987 of our establishment to 136 in 1998, which shows the safety level has been improved steadily.

But we have not accomplished our safety goal of exterminating fatal accidents yet, and activities from the new point of view are, therefore, required in order to step a higher level of safety. We think it important at first to know the exact views and consciousness of the front line employees and identify the new safety policies based on them.

In 1992, Safety Research Laboratory made "follow-up survey for CS Activities" to comprehend employee's evaluation of the activities carried out so far, and proposed the next objectives of them. In 1998, we again made a questionnaire survey named "Try for Further Safety" to all the employees in order to sum up their opinions of what they have done in the activities, what they think about the present situation of our company's safety, and what is needed for further safety.

II. SUBJECTS AND METHOD OF THE SURVEY

The survey can be broadly divided into the following.

1) Action to hallenge Safety activities and its effect

What is your perception of how Challenge Safety activities (CS activities) are conducted and what changes they are bringing about in the workplace and employees themselves?

2) Safety climate in a workplace

How steadily do you think he workplace climate that respects safety has been progressed, and what will be needed to raise them higher?

3) Toward further improvement of JR East safety

What matters do you consider to be important in further improving safety at JR East?

Questionnaires were distributed to all the employees of our company except those in head office and on loan to other companies, and collected by June 1,1998. The number of distributed was 66,365, and collected was 51,127, that is, the response rate was 77%.

III. RESULTS

The following is an outline of the results of this research.

3.1 Action to hallenge Safety activities and its effect

Two-thirds of employees engage in CS activities ery actively or ather actively The ratio of these two choices increased almost 6%, compared with the result of the 1992 survey, which suggests that employees has taken more action in the workplace. (Fig. 3.1)

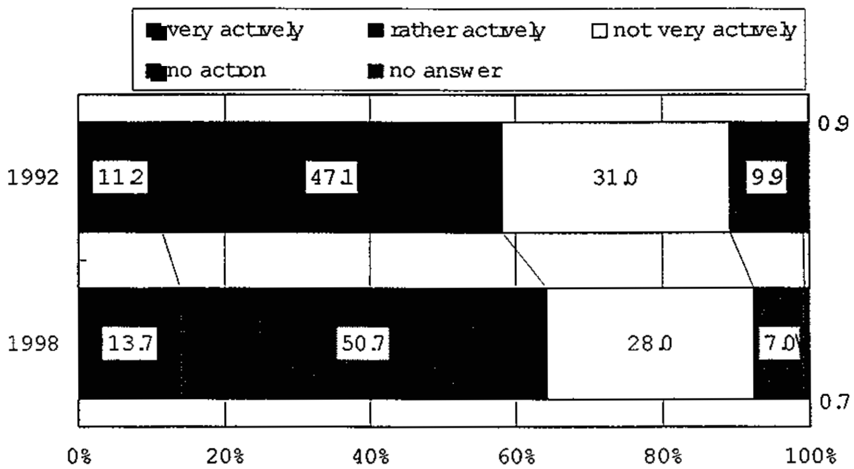
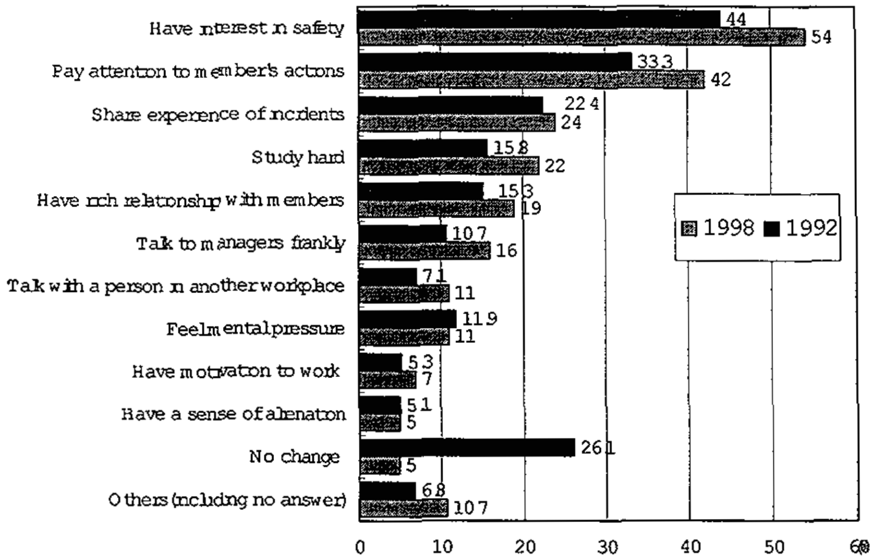


Fig. 3.1: Employee action to CS activities

Concerning ffect of CS activities more than half employees think they ave more interest in safety through the activities, and ay more attention to member action follows at the rate of 42%. In addition, it is remarkable that the negative answers of o change decreased and the positive ones increased instead, compared with the result in 1992. We can say that CS activities fix steadily in a workplace and many employees feel the effect of them clearly. (Fig. 3.2)



Note: Three or fewer items are asked to choose out of eleven.

Fig.3.2: Effect of CS activities

Regarding resent workplace atmosphere 47% of the employees feel can speak freely about anything or can speak rather freely On the other hand, cannot speak freely accounted for only 12%. Compared with 1992, the rate of can speak freely goes up from 13% to 22%, while that of cannot speak freely fell from 22% to 12%, that shows a significant improvement in workplace atmosphere in the past five years. (Fig. 3.3)

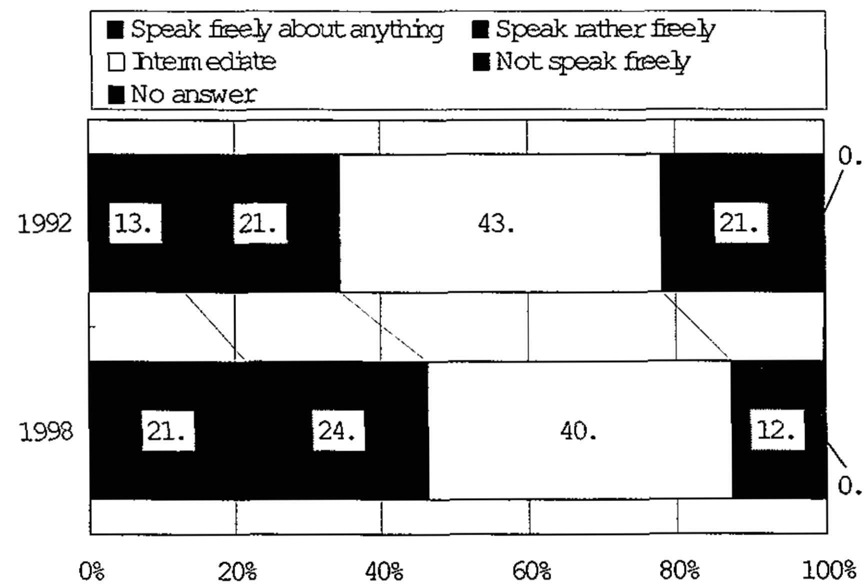
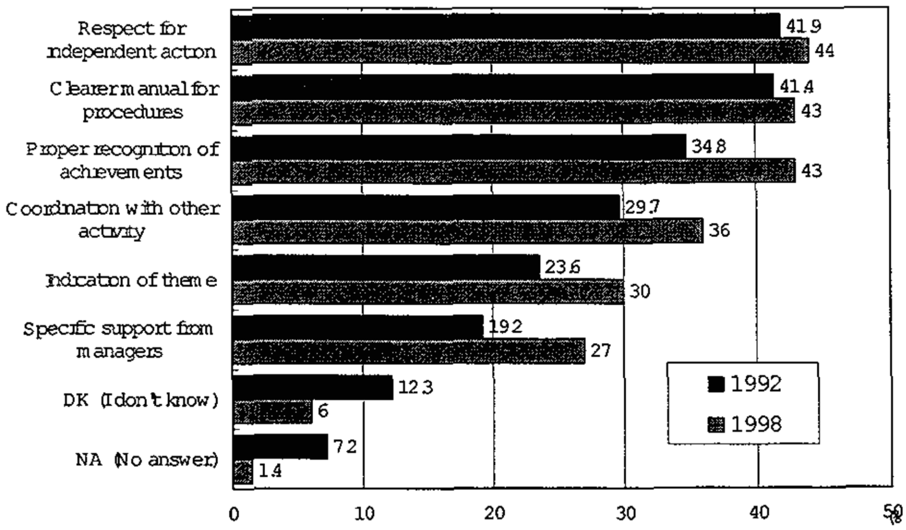


Fig.3.3: Present workplace atmosphere

On oints managers should pay attention to for future development of CS activities there has been a remarkable decrease compared with 1992 in negative responses, such as do not know or o answer with a corresponding rise in the proportion of responses which actively point out future issues. Particularly large increases were seen in replies of would like more respect for independent action would lıke a clearer manual for procedures and would like proper recognition of achievements The fact that the greatest response rate was espect for ındependent action suggests employees deeper understanding of the essence of CS activitıes and greater motivation for more independent actıvities. The next highest response rates were accounted for by learer manual and roper recognıtion whıch give the suggestion of future issues relating to guidance and support in CS activities. (Fıg 3 4)



Note: Three or fewer items are asked to choose out of seven.

Fig 3.4: Points managers should pay attentıon to for future development of CS activitıes

3.2 Safety climate in a workplace

About 60% of the employees feel safety climate ın a workplace has grown up aırly or little while less than 10% declined airly or lıttle (Fig.3 5)

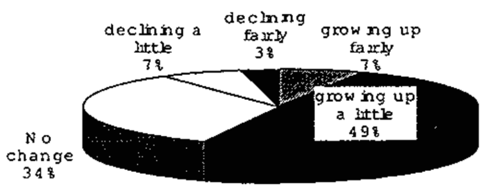
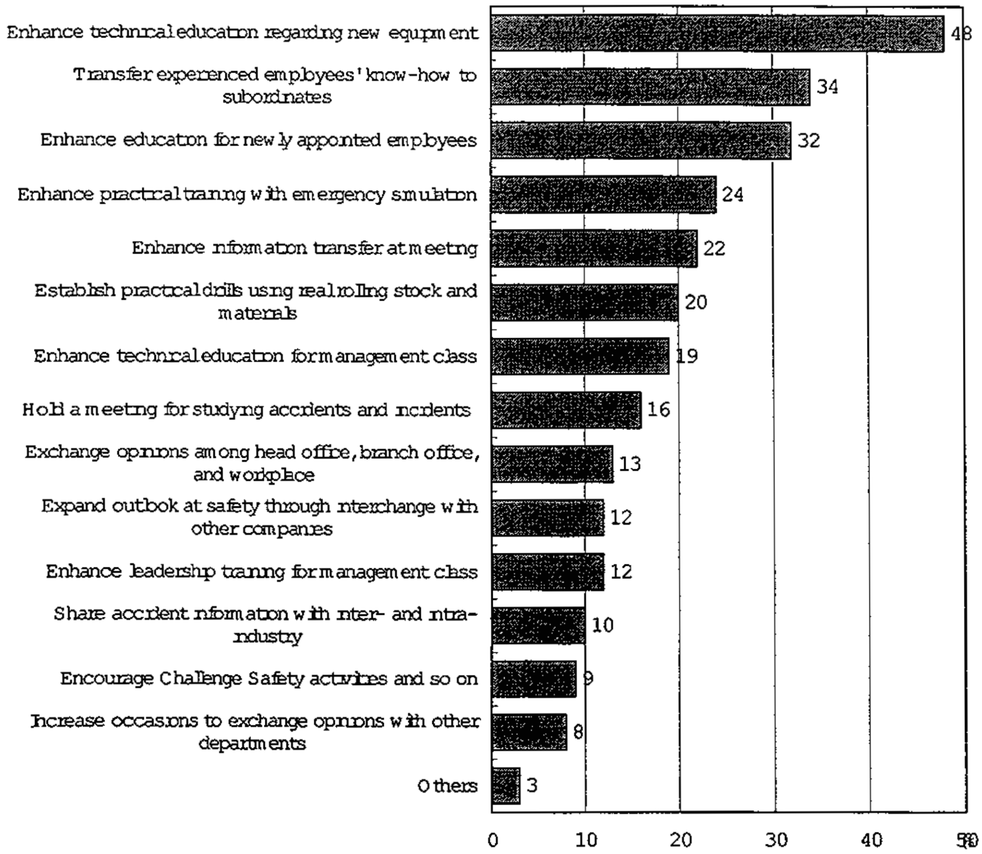


Fıg. 3.5. Change of safety climate in a workplace

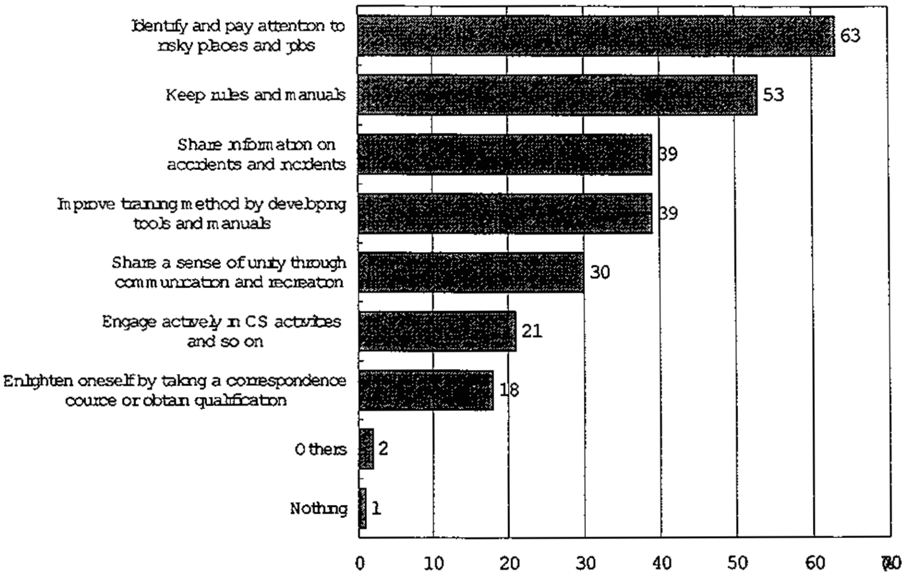
In response to a question about easures for growıng up workplace safety culture numerous employees placed importance on nhance technical education regarding new equipment ransfer experienced employees know-how to subordinates and nhance education for newly appointed employees Employees think it important to enhance practical education in response to environmental changes in the company, such as mechanizatıon and systematization of work, and changes in composition of employee age. (Fig3.6)



Note: Three or fewer items are asked to choose out of fifteen.

Fig. 3 6 Measures for growing up workplace safety culture

As actions employees plan to take for growing up workplace safety culture, 63% chose dentify and pay attention to risky places and jobs and 53% eep rules and manuals which will be conducted just during their main job. On the other hand, ngage actively in CS activities and so on and nlighten oneself by taking a correspondence course or obtain qualification on which they would spend the time except their main job are just supported low. (Fig3.7)

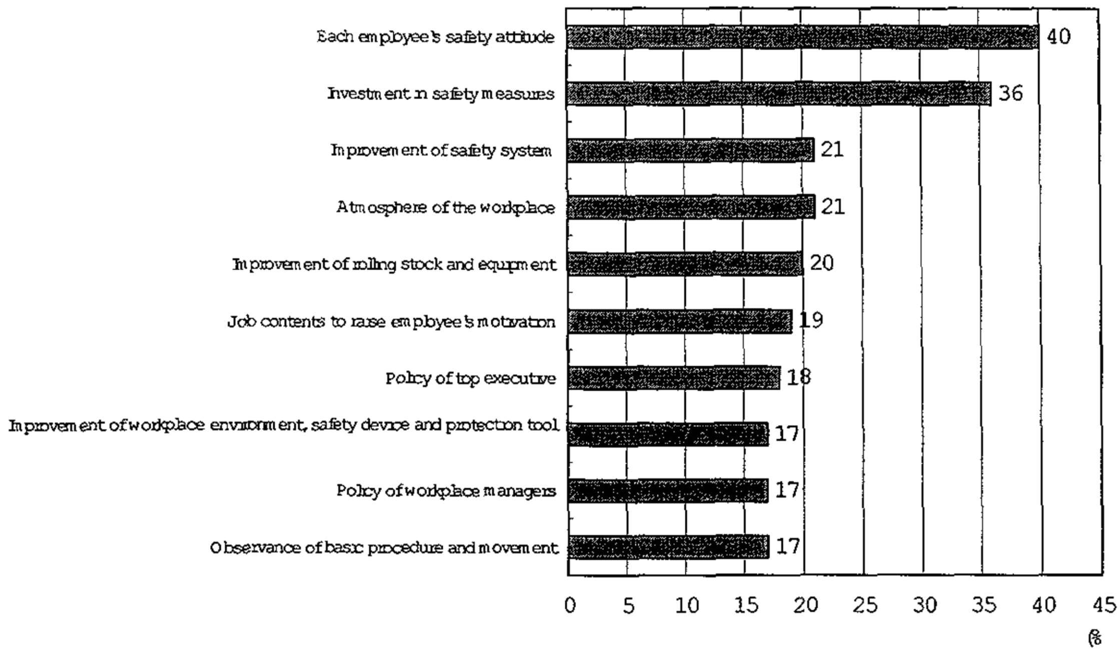


Note: Three or fewer items are asked to choose out of nine.

Fig. 3.7: Employee actions for growing up workplace safety culture

3.3 Toward further improvement of JR East safety

Concernıng effectıve approaches to raıse the safety level of our company, ach employee safety attitude and nvestment in safety measures which we can say the fundamental safety principles of our company were ranked far higher than the other choices. Measures pointed in the mıddle cover safety hardware systems that should be introduced with high priority and safety software systems to raise our safety culture through enhancing employees motıvation, both of which can be meant to realıze the principles. (Fig.3.8)



Note· Three or fewer items are asked to choose out of twenty-one.

Ten items given higher ratios are shown ın the figure.

Fig. 3.8· Approaches to raıse the safety level of our company

IV. EMPLOYEE VIEWS FOR PROGRESS OF SAFETY

At the end of the questionnaire, we asked the employees to give a suggestion for further progress of our company safety in open answer. Fifty seven percent of them, that would be a fairly high rate, stated their views on the sheet. The following are just a slight part of them.

"As safety systems are supplementary measures, it is necessary for each employee to strictly abide by basic procedures and movements with an awareness of safety".

"A system should be put in place to ensure that the opinions of on-site employees are relayed to upper management without getting lost half-way".

"Hazard information and safety opinions brought to the JR East management by not only employees but also passengers should be properly treated. Both of employee safety and passenger safety should be considered".

"While capital investment for safety systems is required, it is also important to educate staff to enable such systems to be fully utilized. Training to deal with situations where the systems go down is particularly needed".

V. SUMMARY AND FUTURE APPROACH

With more than half of all employees actively participating in them, evidence is that our CS activities are steadily spreading and making significant contribution to rises in climate that respects safety Furthermore, with as many as 20% of employees sensing a change at workplace level rather than individual level with ncreased sense of workplace unity and etter human relations in workplace it appears that the CS activities are shifting from the ncouragement and xpansion stage to the aturing one. Nevertheless, there are also stronger calls for espect for independent action learer manuals for procedure and roper recognition of achievements

Meanwhile, ach employee safety attitude and nvestment in safety measures are viewed as vital in boosting safety within the company, pointing to a recognition that safety attitude by each employee combines with specific safety measures to support the basis of railway safety.

Based on these results, it will be important with regard to CS activities to provide support appropriate to the level of workplace activity for their continuation and further development. Also important for improvement of safety of our company will be the implementation of measures according to the needs of the workplace, with afety attitude by each employee and nvestment in safety measures as the two main pillars. It will be essential for that purpose to have sufficient discussion on he specific form of the goals and aths to them and clarify these with employees.

The results of this survey were fully utilized as basic data for the formulation of JR East new basic safety plan (called afety Plan 21 , and a condensed version presented to all the employees via a company's internal publication. Since the implementation of safety measures should be based upon workplace issues and employees need, we will make use of the results of this survey in compiling future issues to be addressed.

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Banff Springs Hotel, Banff National Park, Alberta, Canada

Paper 9925

Don Davis

A Review of Locomotive Engineers Extended Hours of Service

Publisher
2000 International Rail Safety Conference

CURRICULUM VITAE

Don Davis
Corporate Manager Quality & Safety
Tranz Rail Limited
New Zealand

Don Davis from Tranz Rail Limited, New Zealand

Corporate Manager Quality & Safety

Commenced working in the Transport Environment as a graduate professional engineer. Member of the NZ Institute of Professional Engineers.

Has held many positions in the Company during his career. Has been a team member of the Corporate Quality & Safety Unit for the last 10 years and is currently the team leader for the Unit.

The purpose of the unit is to provide strategic direction and overview Tranz Rail's systems and risk management programmes.

Key issues that Don is currently directly involved in:

Safety System, Management of Quality Audit Programme

Risk Assessments for Safety Management

Company's liaison with rail regulatory authorities

Legal issues resulting from occurrences

Mainline derailments

Crisis Management planning for the Company

Support and training to line Managers

A Review of Locomotive Engineers Extended Hours of Service

Mr Don Davis

Corporate Manager, Quality & Safety, Tranz Rail Ltd

9/10/99

1 INTRODUCTION

This paper is a summary of a study undertaken for Tranz Rail by the University of Otago at the Wellington School of Medicine, Sleep/Wake Research Centre by the Associate Professor, Philippa Gander, Dr Annette Nesdale and Leigh Signal. The summary provides an overview of the aims, methods, main findings and conclusions of the study.

2 AIM OF STUDY

The main aim of this study was to assess the prevalence and effects of shifts that are rostered to exceed 10 hours (rostered extended shifts), as worked by Tranz Rail's locomotive engineers. Information was also gathered on other issues of concern in the current rosters, and on the health and job satisfaction of the engineers and the effects of shiftwork on their life external of work. The study was commissioned by Tranz Rail, with the co-operation of the Rail and Maritime Transport Union (RMTU).

3 BACKGROUND

At the beginning of 1995, a roster change was implemented that permitted locomotive engineers at Tranz Rail to be rostered for duty periods that exceed 10 hours (extended shifts). In November 1997, Tranz Rail requested that the Sleep/Wake Research Centre undertake an objective review of the effects of extended shifts, in accordance with the agreement reached with the Rail and Maritime Union at the time rostered extended shifts were introduced.

This change represented the formal introduction of occasional rostered extended shifts in a context of somewhat irregular and unpredictable rosters (by comparison with classical 2-shift or 3-shift systems in manufacturing, for example). Previously published studies on the effects of extended working hours do not address this issue directly. Typically, they focus on comparing stable rosters of 8-hour shifts with stable rosters of 10-hour or 12-hour shifts.

Theoretically, extended operations have the potential to reduce safety margins because they can increase two known causes of engineer fatigue, these being:

1) time-on task fatigue can accumulate to higher levels by the end of an extended work period, particularly if the workload is high and opportunities for breaks are limited; and

2) extended work periods reduce the time available for all activities outside of work, and can thus increase the risk of engineers not obtaining enough sleep, leading to degraded alertness, performance, and mood.

3) Extended night shifts might be expected to produce particularly high levels of fatigue, as they also require engineers to work through the time of day when the physiological drive for sleep is strongest and performance capacity is lowest. On the other hand, extended shifts could conceivably reduce fatigue in some situations. For example, on the Tranz Alpine run, it is possible that returning to Christchurch in the same day, rather than spending the night in Greymouth, could enable engineers to obtain better sleep if they have good sleeping facilities at home. Engineer fatigue is a recognised safety issue in rail operations, and has been identified as a causal factor in a number of major rail accidents.

The potential effects of extended shifts on safety and health could be expected to be modified by:

- how often they occur;
- whereabouts in the roster they occur, with respect to other demanding shifts, and with respect to opportunities for rest and recovery;
- attributes of individual engineers (age, training, etc); and
- how much additional disruption extended shifts cause to the engineer's life away from work.

4 STUDY DESIGN

It was agreed that the scope of the study would be limited to the Christchurch, Palmerston North, and Te Rapa centres, where rostered extended shifts are most common. Ideally, to measure the effects of the introduction of rostered extended shifts, relevant information would be collected prior to the change and then the same information would be re-assessed at a designated time after the change. In the present case, however, no systematic data collection was done before the introduction of rostered extended shifts.

This was addressed in two ways:

1) Timesheet data were examined for the six month period immediately before the introduction of rostered extended shifts, and a six month period (at the same time of year) three years later.

   This permitted assessment of any changes in:

   - how often engineers worked shifts longer than 10 hours;
   - the number of hours worked per fortnight;
   - how often engineers worked on a rostered day off;

- the use of annual leave; and
- the use of sick leave.

2) A set of three questionnaires were designed that asked engineers, people living with them, and Tranz Rail management at each of the three centres, to compare the effects of extended and normal shifts that are ***currently worked***. The engineers at each centre were asked to compare four specific rostered shifts that they currently work. The people living with the engineers, and Tranz Rail management, were asked to compare shifts longer than 10 hours with normal shifts, but particular shifts were not specified (see footnote 1).

The study also provided an opportunity to assess other issues of concern in the current rosters, to evaluate the general health and job satisfaction of the engineers, and to evaluate the impact of shiftwork on their lives outside of work on the people living with them. The study design methods were reviewed and approved by the Canterbury, Manawatu-Wanganui, Waikato and Wellington Regional Ethics Committees.

5 METHODS

Payroll data was gathered for the six months immediately prior to the introduction of rostered extended shifts (27 August 1994 – 25 February 1995) and paired with payroll data for the equivalent six month period three years later (23 August 1997 – 21 February 1998). The payroll data was used to assess changes in work patterns, and in the use of annual leave and sick leave, since the introduction of rostered extended shifts. The payroll data (shifts worked) for the 1997/98 study period were also matched to the rostered shifts for that period, to assess how well current rosters reflect what is actually working. The combined databases were developed and kept at the Wellington School of Medicine, and once the data sets were matched, all information that could identify individual engineers was deleted. Matched data were available for 158 engineers, which represented 90% of the current workforce at the three centres.

Three questionnaires were developed, in consultation with engineers at the three centres and representatives from Tranz Rail and the RMTU:

- one for engineers;
- one for people living with them; and
- one for local Tranz Rail management.

These compared the effects of long and normal shifts and night shifts that are currently worked. Questionnaires, with stamped and addressed return envelopes, were mailed to the engineers at their home address, and participation was voluntary and anonymous. Completed questionnaires were received from 126 engineers (71% response rate), together with 115 completed questionnaires from the people living with them. Completed management questionnaires were received from 12 operations controllers, terminal managers, and trainers (55% response rate).

6 RESULTS

6.1 ROSTERED EXTENDED SHIFTS

Prior to the introduction of ***rostered*** extended shifts, 12% of all shifts ***worked*** exceeded 10 hours. Currently, 11% of shifts are ***rostered*** to exceed 10 hours, 18% of shifts ***worked*** exceed 10 hours. There has been no increase in work hours overall, except in Christchurch, which has had an average increase of 110 minutes per fortnight. There has been no change in the use of annual leave, but there has been an increase in the use of sick leave, despite the introduction of more restrictive sick leave allowances. It is not possible to determine how much to this increase in the use of sick leave is attributable to roster changes.

Engineers were asked to compare the effects of rostered extended and normal night shifts and day shifts on:

- fatigue at the end of the shift;
- nodding off in the cab while moving and when parked;
- covering sections of track that they could not recall;
- how well they were driving the train by the end of the shift; and
- how often the nodded off driving home after the shift.

Rostered extended night shifts were rated as worst on all of these measures. Rostered extended day shifts were rated as no worse than normal night shifts, and normal days shifts were rated as best. People living with the engineers were asked to rate the effects on the engineers' fatigue and irritability of long[1] and normal night shifts and day shifts. They gave the same ranking of shifts as did the engineers. Respondents on the management questionnaire reported that engineers were more fatigued by the end of long night shifts than by the end of long day shifts. They also indicated receiving more complaints, and safety concerns raised by engineers, about long night shifts than about long day shifts.

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[1] Long shifts were defined as shifts exceeding 10 hours. Specific couplings were not identified in the questionnaire for the people living with the engineers, because it was considered that they might not be sufficiently familiar with this terminology. Specific couplings were not identified in the questionnaire for Tranz Rail management, so that the data from all three centres could be pooled, since there were only 22 people to whom this questionnaire could be sent.

Engineers were asked to rate the effects of rostered extended and normal night shifts and day shifts on their leisure activities and responsibilities at home. The people living with the engineers were asked companion questions about how long and normal, night shifts and day shifts affected them. Both groups identified long shifts as interfering more than normal shifts. The people living with the engineers reported that long night shifts were most disruptive. On the other hand, the engineers found that rostered extended day shifts interfered most with their responsibilities at home, while rostered extended day shifts and rostered extended night shifts were equally disruptive of their leisure activities.

6.2 OTHER ASPECTS OF CURRENT ROSTERS

Changes to the rosters at short notice (shifts brought forward, or changes to longer shifts) were reported by the engineers to occur about once a month on average. In contrast, they reported working an average of four shifts in the preceding month that had run late. Comparison of the payroll and rostering data for the 1997/98 study period confirmed that shifts, on average, ran five minutes longer than was allowed in the roster. The discrepancy was greatest at Palmerston North, where the average shift ran 12 minutes longer than that was rostered. At Palmerston North, 26 couplings were identified that ran at least fortnightly and that ran late at least 50% of the time.

Engineers worked on most rostered relief shifts (84%) and rostered standby shifts (75%). The duration of the shifts worked varied greatly, but on average, they were comparable to regular rostered shifts (8-9 hours). In the 1997/98 study period, there were 46 days on which engineers started two shifts on the same day. Typically, this included an early shift, followed by a 12-hour break during the day, and then a night shift. Engineers worked (on average) 1/5 of their rostered days off, and no engineers had a 2-day break every week. Only half had a 2-day break every fortnight.

The engineers and the people living with them were asked to identify the hardest shift that the engineer worked, and to indicate why it was hard. Most engineers (74%) identified specific shift couplings. Rostered extended shifts accounted for 56% of the hardest couplings identified by Christchurch engineers, 11% of those identified by Palmerston North engineers, and 24% of those identified by Te Rapa engineers. Of the couplings identified by Palmerston North engineers, 54% were shifts that ran at least weekly and ran late at least 50% of the time. Sleep problems predominated among the engineers' reasons for what makes a shift hard (cited by 31%), followed by fatigue (cited 18%), and issues of shift duration and workload (each cited by 12%). Most people living with the engineers (88%) identified night and early shifts as being the hardest for the engineers, and concerns about sleep predominated among the reasons given (cited by 56%).

6.3 HEALTH AND WELL-BEING OF THE ENGINEERS

The engineers were very experienced shiftworkers (average age 46 years, average shiftwork experience 27 years). Most (91%) were married, and 55% reported having dependants living with them. They considered that they received a high level of support at home, and this is borne out by the high response rate on the questionnaire for people living with them (91%). Both groups rated Shiftwork as causing moderate problems for their social life, home-life, and personal relationships, with the problems rated as worse by the engineers.

The engineers reported getting a normal amount of sleep on nights off, but were nevertheless sleepier than other groups of men of similar age, and appear to have a higher prevalence of risk factors of obstructive sleep apnoea (a common sleep disorder) than a random sample of Wellington men. Night shift paralysis (freezing momentarily on the job when extremely tired) was reported to be a regular occurrence by 11% of engineers. One in four reported regular symptoms of gastrointestinal upset, 5% reported regular symptoms of cardiovascular illness, and 10% were currently being treated for high blood pressure. About half rated their overall health as good or excellent. However, 36% reported that they rarely or never engage in regular physical exercise.

Overall, engineers were not very satisfied with their rosters, over which they felt they had very little control. On the other hand, they were generally able to get annual leave and lieu days when they wanted them.

7 STUDY LIMITATIONS

There have been a number of other changes in the rosters, and in working conditions, since the introduction of rostered extended hours, which may have contributed to the observed increase in the use of sick leave. The number of extended shifts rostered and worked is known reliably, from the roster and payroll data. However, all the information on the effects of extended shifts comes from subjective reports. Nevertheless, the findings overall are consistent and plausible.

8 CONCLUSIONS AND RECOMMENDATIONS

Keeping in mind the study limitations, the following conclusions and recommendations are proposed.

1) Prior to the introduction of rostered extended shifts, 12% of all shifts worked lasted longer than 10 hours. Currently, 11% of shifts are rostered to exceed 10 hours, and 18% of shifts worked exceed 10 hours.

2) Rostered extended night shifts were rated by the engineers as causing the most fatigue and reduction in driving performance. The people living with the engineers, and local Tranz Rail management also indicated that night shifts lasting then 10 hours were particularly challenging.

3) Sleepiness during and after rostered extended night shifts is a potential safety concern.

4) Rostered extended shifts were rated by the engineers as having a greater effect on life away from work than normal shifts. Similarly, shifts longer than 10 hours were rated by people living with the engineers as having a greater effect than normal shifts.

5) Rostered extended shifts are not the only shifts that the engineers find challenging. Night work and late running are major concerns.

6) In the interest of better planning for rosters, train controllers, and engineers, the rostered time of couplings that consistently run late should be reassessed.

7) It is recommended that engineers have a 2-day break at least once a fortnight, and preferably once a week.

8) Rostering two starts on the same day should be avoided as much as possible.

9) Existing education programmes for fatigue management, and the established procedures for diagnosing and treating engineers with obstructive sleep apnoea, need to be fully implemented and widely publicised in the workforce.

10) The need for recurrent fatigue management training should be investigated, and appropriate strategies implemented.

11) Attention should be given to providing engineers with good information about diet, and to the food available to them at work. Opportunities and encouragement for engineers to be more physically active would be expected to be beneficial.

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Paper 9926

Yutaka Toyoshima

Lessons from a Fatal Accident to Subcontracted Workers on Yamate Freight Line

Publisher
2000 International Rail Safety Conference

YUTAKA TOYOSHIMA

CHAIRPERSON, TRACK, ELECTRICITY AND CONSTRUCTION ENGINEERS' ORGANIZATION EAST JAPAN RAILWAY WORKERS' UNION

Mr. Toyoshima is chairperson of the tracks, electricity and construction engineers' organization of the JREU and works as track maintenance engineer in Haijima track maintenance depot in the suburbs of Tokyo.

However, since he entered the former JNR in 1974 he experienced a lot of things. For example, he decided three times to change different unions because of his belief, before privatization of the former JNR in 1986 he was sent on loan to a motorcar factory and has seen technological innovation on his track work. He overcame these hard and changing circumstances. He has worked in railway industry as an experienced engineer.

For these 12 years, 109 rail workers from both JR East Company and contracted companies died by accidents. About 80% are from track maintenance, electricity and construction workers. Therefore, in general track maintenance workers are sensitive about accidents and preventive measures.

Just before he was elected as chairperson in 1999, a fatal accident of the Yamate Freight Line occurred. He discussed preventive measures with his union members and made an effort to investigate cases.

1974	joined JNR as a track maintenance worker and entered National Railway Union
1975	operated a heavy machine, multiple tie tamper and track motorcar
1971	general secretary of unions' youth department of his branch
1986	sent on loan to a motorcar factory and joined a Track Maintenance Workers' Union
1989	worked as an operator of heavy machines in Haijima
1994	was elected President of his branch
1997	was elected as secretary general of JREU track maintenance, electricity and construction engineers' organization, then in 1999 became a chairperson

MASAKAZU TAKAHASHI

DIRECTOR, EDUCATION DEPARTMENT
EAST JAPAN RAILWAY WORKERS' UNION

Mr. Takahashi was appointed director of the education department in JREU headquarters in 1999. He began train union movement in 1979 after joining National Railway Drivers' Union. When East Japan Railway Workers' Union formed in 1987 he joined as a secretray.

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

1999 International Railway safety Conference
October 19-22 1999, Banff Spring Hotel, Canada

Lessons From a Fatal Accident to Subcontracted Workers on Yamate Freight Line

By Yutaka Toyoshima
Chairperson
Track, electricity and construction engineers Organization, JREU

1, Introduction

Accidents to maintenance workers on tracks have been a common problem of people concerned with safety. In Japan in February 1999 five track workers were killed at once. I was terribly shocked by such a number of victims. For these years we have tried to keep safety for track workers but we could not prevent the accident. After the accident we started investigation to learn lessons.

2, Facts of the fatal accident and problems

The accident occurred at 0:14 on 21 February 1999 on the Yamate Freight Line between Osaki and Ebisu Station. Five workers were killed by a temporary special train, #9531, that came from Shinagawa bound for Kobuchizawa. They are from second and third subcontracted companies which contracted with Hoan Kogyo Co. which was one of the subcontractors of the JR East Company. Those workers were heading to the work site to prepare for changing communication cable and carrying necessary materials. This work should be done during the intervals between trains and relying also on a train watcher's attention.

On the same day in the morning, the head of JR East Tokyo Branch, Yoshio Ishida, had a press conference and apologized for the occurrence of the fatal accident. He mentioned about causes briefly. First, the supervisor of this construction work came to work late, no one checked if time tables were changed, and the supervisor forgot to ask for facsimile information from the JR East Company on that day.

Media reported there was a possibility of professional negligence causing death by misadventure. Then this accident became an object of public concern.

I discussed the problems of this accident that took the lives of five people at once with my colleagues. We pointed out reasons:

(1) A checking system for safety had not been established between subcontracted companies and JR East Company and also there was no clear agreement between them.
(2) Although JR East Co.and Hoan Kogyo Co. had a previous arrangement meeting using a "safety arrangement form", there was no check about special train operation. In an agreement JR East Co. should have sent facsimile messages or handed over a special train timetable to subcontractors two days before.
(3) JR East Co. did not confirm whether the subcontractor had received a facsimile timetable. The JR East signaling and communication depot concerning the contracted work did not check if subcontractor and second and third contractors had an arranged meeting on that day.
(4) Subcontractor did not confirm the latest timetable with the concerned station. If we follow a basic rule, after confirming latest train operation we should arrange safe-working procedures, then start work.
(5) There was the possibility that workers started working without being given safety information or with not enough information.
(6) Also there was doubt whether the watcher was on duty with the position where JR East Co. and the contractor agreed before.
(7) How complete was JR East Company's safety control of subcontractors in the first place?

These factors affecting each other caused the accident. I supposed it inevitably occurred. To sum up, at first, regarding relationship between JR East Co. and subcontractors, they did not have any arranged meetings to keep safety before starting work. Second, about the safety system of subcontractors, they started work without confirming safety procedures. They also did not follow necessary safety rules and procedures. Third, there were problems between JR East Company and subcontractors regarding safety management as well as between first subcontractors and second and third subcontractors.

3, Lessons and problems to be solved

Five workers from subcontracted companies lost their valuable lives. I think they scarificed for JR employees, our union members. They were not our union members but we should investigate this accident as our own business. In other words, we were responsible for five lost lives.

As I pointed out in the previous section I have to say an important factor of this accident is structural. We have to reform the structural defect to prevent the same type of accident.

In the last 12 years 108 people died by accidents. 80 % of victims were from subcontractors. Someone said, "They died because they didn't follow safety rules and regulations," but this is wrong. For those years the union has been tackling safety issues and also promoting efficiency cooperating with the management. We have been deeply involved in safety issues in East Japan Railway. Therefore, we have to review safety management and our activities in workplaces to develop our safety system.

Our members at the workplace investigated the following factors:
(1) Way of contract: first subcontractor directly gives second/third subcontractors construction work that JR gives to the first one; it is called "Marunage", that pass along the same work, leaving it as original. In this case the first subcontractor makes profits by being intermediary JR and second/third subcontractors. JR East Company did not know or check who was really responsible for the contract work.
(2) Situation of subcontracted workers: They consist of mostly seasonal workers and a boss controls his followers. So, through daily work a boss orders and followers obey. It is difficult for workers to ask something to his boss. We had given silent approval to such relation among workers.
(3) Negligence of safety system and procedures: JR East Company did not check enough if safety procedures or safety rules were kept at work sites.

For these years after an accident occurred we carried out basic safety countermeasures, for examples, keeping basic actions, following right work procedures, making new rules, using computers and so on. However, regrettably, accidents have occurred one after another.

Through accident investigation, especially the fatal accident to five workers, I learned human lives are absolutely valuable. Therefore, both company and union should recognize "keeping safety is absolutely an essential subject to tackle". Do not punish people who were involved in the accident as a warning and do not take only apparent measures to escape responsibilities, or we cannot proceed correctly and carefully.

4, Conclusion

Today, in our workplaces, from March 1999 we started new keeping safety procedures. That is, we established a principle that we forbade works on tracks with only relying on a watcher's attention, and we start working on tracks after railway track closure. This meant works concerning track maintenance shifted from day work to night. It resulted in reduction of quantity and efficiency of work. At that time employees in workplaces tended to insist on priority for work rather than safety.

We discussed with our members again and again and concluded that keeping this principle protected our colleagues' lives and would produce a new safety system. I believe that gradually, the atmosphere and circumstances in workplaces for keeping safety have been reformed.

We will never compromise about keeping safety. Standing on the point of view, "to protect a colleague's life is to protect mine", I will make efforts to improve the safety system of our workplaces regarding track maintenance, electricity and construction sections. Then, based on these activities, I would like to make a safer and more reliable railway system in the next century.

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Paper 9927

Ms Elizabeth McCullough
Randy Gnam

The Safety Investigator
The TSB approach to accident investigation

Publisher
2000 International Rail Safety Conference

Biographies - McCullough and Gnam

ELIZABETH MCCULLOUGH and RANDY GNAM *The Safety Investigator - the TSB Approach to Accident Investigation*

RANDY GNAM

Randy has successfully completed numerous managerial, academic and technical courses provided by Lampton Collage, Mount Royal College and Algonquin College as well as the public sector's senior management training programs. Prior to entering a career with the public sector in 1982, Randy held various trade and supervisory position within Canadian Pacific Railway. Between 1982 and 1990, Randy held regional and head office compliance monitoring positions with the Canadian Transport Commission and the National Transportation Agency of Canada.

Randy has been with the TSB since its creation in 1990 and has participated in numerous railway investigations. He was the Investigator In Charge of the TSB's investigation into the derailment of VIA Rail's cross country passenger train the "Canadian" near Biggar, Saskatchewan in September of 1997.
Randy is currently the Manager of Head Office Investigation Operations with the Transportation Safety Board of Canada. This position is responsible for maintaining the operational readiness of a team of railway specialist accident investigators in three railway disciplines: Locomotive Operations, Rolling Stock Equipment and Track/Signals infrastructure along with maintaining a transitional team of safety analyst/investigators. He was a member of the multi-modal team that developed the Integrated Safety Investigation Methodology (ISIM) which has lead to the "Safety Investigator" approach adopted by the TSB.

ELIZABETH MCCULLOUGH

Elizabeth McCullough holds a BA in psychology and is currently working part-time on her MA in psychology at Carleton University. She joined the Canadian Aviation Safety Board in 1985 as the English editor of aviation investigation reports and began her career in accident investigation in 1989, participating in the investigation of human factors in aviation occurrences. With the inception of the TSB in 1990, she joined the Human Performance Division as a Human Performance Specialist, a position which she currently holds. As a Human Performance Specialist, Elizabeth has participated in the investigation of numerous occurrences in all modes and has been Group Chair of several major aviation occurrences. She was a member of the multi-modal team that developed the Integrated Safety Investigation Methodology (ISIM) which has lead to the "Safety Investigator" approach adopted by the TSB. She is currently the project manager of the ISIM training development and implementation program.

THE SAFETY INVESTIGATOR - THE TSB APPROACH TO ACCIDENT INVESTIGATION

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Abstract

The Transportation Safety Board of Canada (TSB) is a multi-modal accident investigative body that has only one mandate, namely to advance transportation safety through the identification and analysis of safety deficiencies. Until recently, the safety deficiency identification and analysis functions were carried out by two separate branches of the organization. As a result of several initiatives, however, the TSB has now amalgamated those functions. Because each of the functions required different skills sets, it was determined that a methodology that integrated the two functions was needed to assist both investigators and safety deficiency analysts in following a systematic approach to occurrence investigation. Although there were several commercial investigation methodologies available for assisting investigators, none was found that adequately fulfilled the needs of the TSB.

In 1998, a methodology for integrating the identification with the analysis and validation of safety deficiencies was developed in-house and presented to senior management at the TSB. The Integrated Safety Investigation Methodology, known as ISIM, assists investigators in the identification and analysis of safety deficiencies, focussing attention on unsafe acts and the unsafe conditions that can result in those unsafe acts, and then leading investigators through a process of analysis and validation of those conditions to determine their associated risks and the adequacy of their defences. The TSB is currently in a transitional process, training its investigators and analysts in the use of ISIM.

The impetus for the development of the methodology, including an analysis of the needs of the investigators and analysts, as well as a description of ISIM will be discussed.

The TSB - Historic Perspective

In 1990, the Canadian Transportation Accident Investigation and Safety Board was formed. Known as the Transportation Safety Board (TSB), the Board is a multi-modal agency, tasked with investigating federally regulated marine, rail, pipeline and aviation occurrences. To ensure fairness, openness and independence in performing this function, the Government of Canada has provided the TSB with legislation that separates the accident investigation function from the regulation and enforcement functions of other government agencies, as well as from criminal and civil proceedings. The TSB does not regulate, it does not enforce, it does not assign blame, it does not apportion liability. The sole purpose of TSB investigation is to advance safety through the identification of safety deficiencies in the transportation system.

Approximately 4000 transportation-related occurrences are reported to the TSB each year, a daunting number for an agency which employs a staff of 220 full-time persons, half of whom are investigators. Numbers alone require that the Board use its resources in an efficient and effective way. To that end, the TSB focuses on investigating those occurrences that offer the greatest potential for safety pay-off, that is, those occurrences for which there is the potential to advance transportation safety.

TSB Operations

In pursuing the Board's mandate, TSB investigators are charged with the responsibility of taking a systems approach to investigation. This type of approach focuses the investigation on the identification of latent unsafe conditions residing in the transportation system. Once unsafe conditions are identified, they are analysed to determine if they constitute safety deficiencies. The validated safety deficiencies along with an argument for change are then communicated to the authorities who can best effect that change, such as the regulator or the rail industry. The goal of the communication process is to prepare an argument that is so compelling that the change recommended will be accepted.

From the time of its inception in 1990 until recently, two separate branches of the TSB fulfilled the functions of safety deficiency identification and safety deficiency analysis, the first by the investigation branch and the latter by the safety analysis and communication branch. Investigators identified what they perceived to be deficiencies and then handed the deficiencies over to safety analysts for analysis, validation and communication. This bifurcation of the investigation process created difficulties in workload and in timeliness and frustrations developed in both branches and across all modes.

Through a number of TSB initiatives, including a strong united voice from investigators and analysts, it became apparent that the TSB would be more efficient and effective if these two functions were integrated. By combining the two functions into one, it was foreseen that, from the start, the focus of the investigation would be on the identification and validation of safety deficiencies. Therefore, investigators and analysts would become "safety investigators", no longer distinguishable from one another, and each with the same roles and responsibilities for advancing transportation safety.

TSB Integrated Safety Investigation Methodology

Recognizing that TSB investigators and safety analysts utilized different skill sets, it was determined that a methodology was needed that combined the two functions and ensured that both skill sets flourished. Although there were several commercial investigation methodologies available for assisting investigators in following a systematic approach to occurrence investigation, none was found that met the specific and unique needs identified by the TSB.

In late 1997, a team of peers representing all branches of the TSB was formed to develop an in-house methodology that would encompass all aspects of our investigation process. In 1998, the Integrated Safety Investigation Methodology, a comprehensive, integrated methodology for the investigation and safety analysis of transportation occurrences, was presented to senior management at the TSB. Known as ISIM, the methodology assists investigators in all modes in the identification and analysis of safety deficiencies, focussing attention on unsafe acts and the unsafe conditions that can result in those unsafe acts, and then leading investigators through a process of analysis and validation of those conditions to determine their associated risks and the adequacy of their defences.

ISIM

The goal of ISIM is to ensure that both investigation and safety deficiency analysis are integrated throughout the investigation and that adequate communication is provided to all stakeholders and interested parties. The methodology comprises eight major components: Occurrence Assessment Process, Data Collection Process, Occurrence Sequence of Events Process, Integrated Investigation Process, Risk Assessment Process, Defence Analysis Process, Risk Control Option Analysis Process and Safety Communication Process (see Figure 1). Each process has its own product and each product feeds into the next process. While the products are important, it is the processes that provide the methodology with its rigour as they bridge the gaps between the identification and the validation of an unsafe condition as a safety deficiency.

Although the methodology appears linear in the figure, during an investigation, many of the processes take place at the same time and some, like data collection and communication, are on-going throughout the investigation. A description of each of the ISIM major components follows.

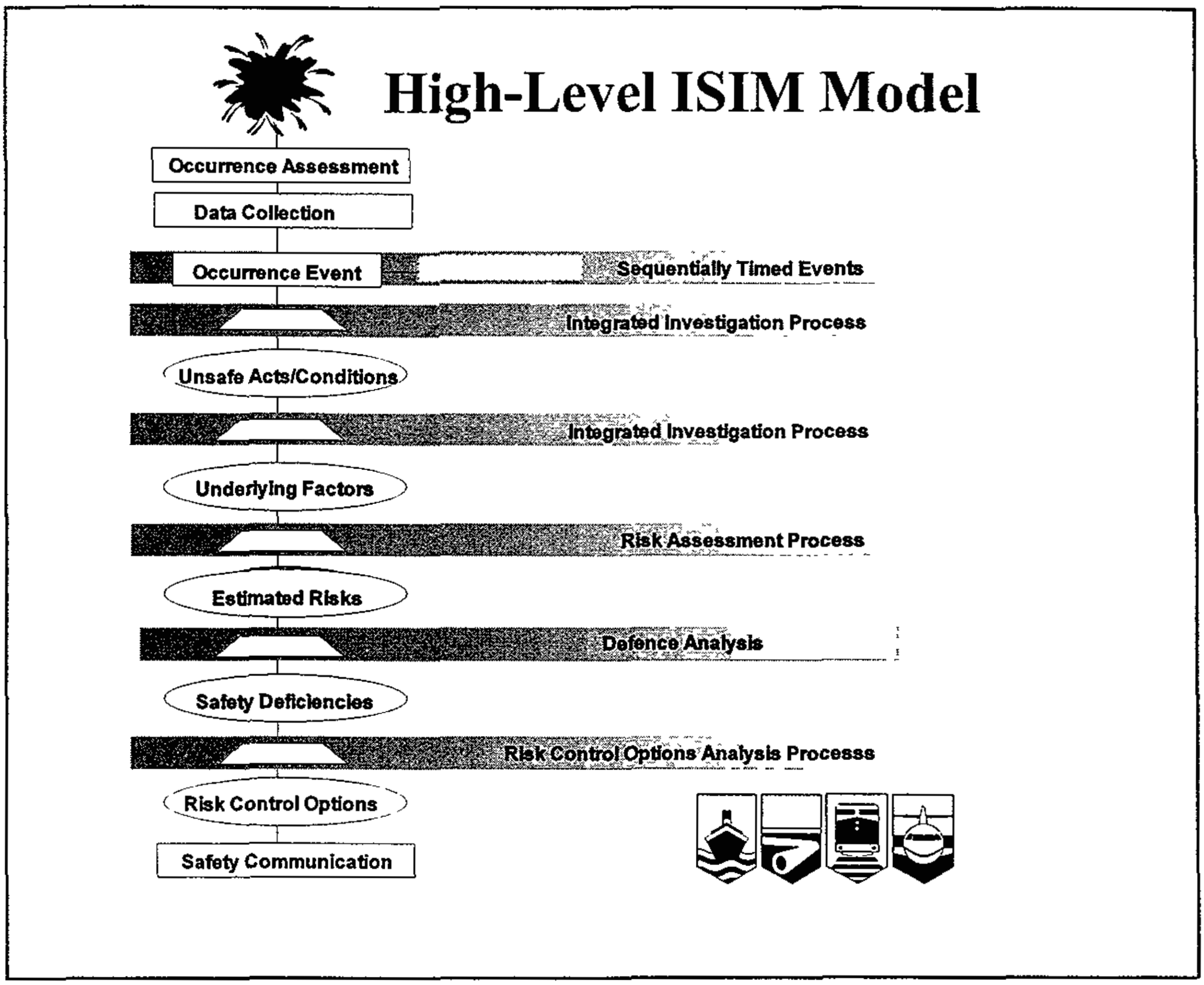

Figure 1 - ISIM Major Processes and Products

Occurrence Assessment Process

Many accidents and incidents occur each year. Some cases immediately proceed to an investigation due to the severity of the accident or the number of people affected. Many cases, however, require an initial assessment to determine whether the TSB should conduct an investigation and, if so, how extensive that investigation should be.

The occurrence assessment process begins with receipt by the TSB of notification of an occurrence and is followed by a number of sub-processes and/or considerations that allow the appropriate TSB managers to decide whether to launch a full investigation or not. Included in this process is an assessment as to whether the potential to advance transportation safety is great enough to warrant an investigation. Should the TSB decide to investigate, the following processes would be carried out.

Data Collection Process

The purpose of the data collection process is to collect, collate, and evaluate the data associated with the occurrence in order to identify the occurrence events and their underlying factors. Data collection is not a stage or phase of the investigation but a part of all investigation activities. It provides the information needed to analyse the occurrence; however, since occurrence analysis will invariably raise questions and issues that require further data collection, the process must be iterative.

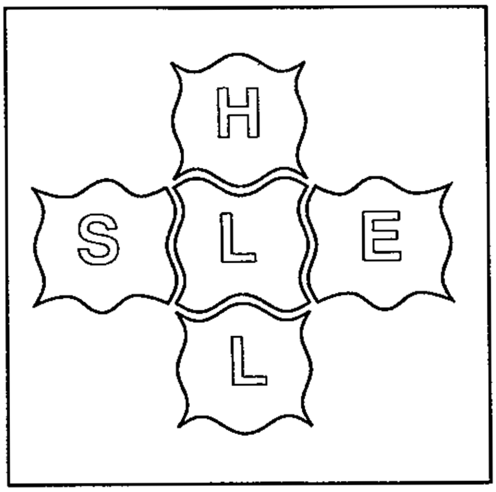

Figure 2 - SHEL Model

Embedded within the data collection process are a number of techniques and models to aid investigators in the systematic gathering of occurrence information, including the SHEL[1] model (Hawkins, 1987) which provides a framework for examining all aspects of the transportation work system (see Figure 2) and Reason's model of accident causation (Reason, 1990) which uses a production framework to show how humans contribute to the breakdown of complex, interactive, and well-guarded transportation systems (see Figure 3).

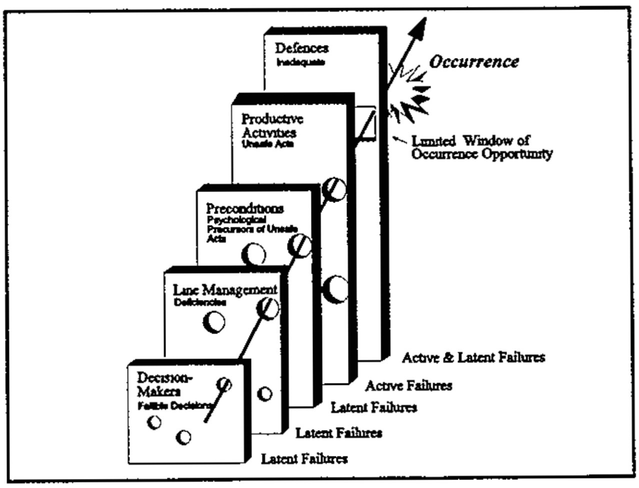

Figure 3 - Reason's Model

As data are collected, they are displayed in a graphic format using the Occurrence Sequence of Events Process discussed below.

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[1] Each of the letters of the SHEL model represents a component of the work system: S - software; H - hardware; E - environment; L - Liveware

Occurrence Sequence of Events - Identification and Display

From the beginning of an occurrence investigation, investigators will collect data that will allow them to piece together the sequence of events that led to the occurrence. Each event describes a single, discrete happening or action step. Essentially, the sequence of events is the "what" of any occurrence and often represents the history of the trip.

In addition to identifying the sequence of events, investigators are required to display these events as part of an events and underlying factors diagram. The diagram is a tool for summarizing, documenting and communicating the results of the investigation. It is also a useful tool for determining what additional information must be collected and what resources are required to do so.

As events are identified, investigators examine them to determine what, if any, unsafe conditions underlie them. The IIP, described below, is fundamental to this analysis.

Integrated Investigation Process (IIP)

The IIP is a process that represents the integration of all operational, technical and human factors frameworks and techniques used by investigators to assist in the identification of unsafe acts and unsafe conditions underlying an event in the occurrence sequence of events. These underlying factors may be indicative of systemic safety deficiencies that put the transportation system at risk. The IIP is applied and then reapplied until the point is reached where no further unsafe acts/conditions can be identified or where conditions identified are beyond control within the transportation system. It is the repetitive nature of the IIP that forces investigators to look beyond the actions and decisions of the front-line operator and into the latent unsafe conditions in the work system that provided the opportunity for the expression of those actions.

The IIP introduces the investigator to several terms that are as important in their distinction as they are in the role they played in an occurrence:

- An unsafe condition is situation or condition that has the potential to initiate, exacerbate, or otherwise facilitate an undesirable event, including an unsafe act.
- An unsafe act/decision is an error (slip, lapse, or mistake) or deliberate deviation from prescribed operating procedures which, in the presence of a potential unsafe condition, leads to an occurrence or creates occurrence potential.
- An underlying factor is an unsafe condition for which no further unsafe acts or conditions apply. An underlying factor is the final unsafe condition identified.

The IIP is conducted according to the following steps:

- Each occurrence event is examined to determine whether the event is a safety-significant event worthy of further investigation and analysis.

- Each safety-significant event is examined to determine if it is an unsafe act or if it has an unsafe condition associated with it.
- All unsafe acts and/or conditions are analysed using applicable analysis methods to uncover other underlying unsafe acts or conditions.
- The process is reapplied until the underlying factors have been identified.
- The unsafe acts/conditions and underlying factors are displayed graphically on the events and underlying factors diagram.

Once investigators have reached the point in their analysis where they have identified the underlying factors, they are in a position to progress those factors to a risk assessment. Only underlying factors and occasionally stand-alone unsafe conditions are progressed to a risk assessment. Unsafe acts are not. In the context of a TSB investigation, unsafe acts are viewed as idiosyncratic behaviour, the analysis of which facilitates the identification of unsafe conditions. Instituting safety action on an individual's behaviour would only serve to correct or mitigate that behaviour. It is the elimination or mitigation of unsafe conditions that best serves transportation safety.

The next two processes in the methodology, Risk Assessment and Defence Analysis, are used to validate the underlying factor as a safety deficiency. A safety deficiency is an unsafe condition/underlying factor with risks for which the defences are less than adequate.

Risk Assessment Process

Once underlying factors have been determined, a level of risk for each factor is assigned. In ISIM, risk is defined and analysed in terms of two main components: the probability that the underlying factor will lead to an adverse consequence(s) and the potential severity of that adverse consequence.

To estimate a level of risk, investigators must determine the probability of the underlying factor leading to the adverse consequence and the severity of that consequence. Probability is assessed over time, using such factors as occurrence history, the defences in place to protect the system, the number of personnel potentially involved, the amount of equipment or kilometres of track that might have similar defects, the adequacy with which previously identified deficiencies have been addressed and the frequency and duration that subjects are exposed to the risk. In determining the severity of the adverse consequence, investigators are required to estimate the potential impact of the consequence on people, property, environment, and often on commercial operations. Based on the results of these two analyses, an estimated level of risk is assigned to an underlying factor (see Figure 4).

		Probability of Adverse Consequences (Over Time)				
		Frequent	*Probable*	*Occasional*	*Unlikely*	*Most Improbable*
Severity of Consequence	*Catastrophic*	High	High	High	Medium	Medium-Low
	Major	High	High	High-Medium	Medium	Low
	Moderate	High	Medium	Medium	Medium-Low	Low
	Negligible	Low	Low	Low	Low	Low

Figure 4 - Risk Matrix

Defence Analysis

A major component of any transportation system is the set of defences put in place to protect people, property, and/or the environment. Defences can be divided into two categories: physical and administrative. Through their absence, misuse, poor design, or insufficiency, defences can contribute to an occurrence. Thus, it is crucial to analyse the defences of the transportation system involved in an occurrence to determine what role they played in causing the occurrence. Less-than-adequate defences are those that are provided but not made known to users; absent or not provided; in place but not practical; or not functioning as intended.

Safety Deficiency Validation

At this stage in the methodology, investigators combine the results of the Risk Assessment Process and the Defence Analysis to determine if the underlying factors constitute safety deficiencies. Validated safety deficiencies are then progressed to the Risk Control Option Analysis for further examination.

Risk Control Option Analysis

Once the safety deficiencies have been validated, investigators begin to devise strategies to eliminate or mitigate the risks associated with the deficiencies. There are normally control options available for any risk control situation, although some will be more effective than others. In formulating strategies, however, investigators, must ensure that the full range of possible control options is considered and that the optimal trade-off between measures is made, as a risk control option may be considered unacceptable by stakeholders if the cost of controlling the risk outweighs the benefits.

Conducting this analysis facilitates progression to the Safety Communication Process, as investigators, having considered the options for change, are in a better position to develop convincing arguments for reducing and/or eliminating safety deficiencies.

Safety Communication Process

One of the most important roles of the TSB is to communicate the safety deficiencies to stakeholders and the public. ISIM is a rigorous process with products that clearly identify the underlying safety deficiencies. Therefore, in its structure, ISIM provides a framework for developing a compelling safety message. The effectiveness of the communication will ultimately determine the effectiveness of the risk control options to enhance the safety of transportation systems.

Training

In late 1998, the TSB contracted the development of an interactive multi-media-based ISIM training course. The 2 1/2-day training course employs group discussion exercises, a computer-based tutorial to provide participants with the knowledge component of ISIM, and a generic case study exercise to develop skills in applying ISIM. The TSB is currently in the process of providing ISIM training to all investigators and analysts and looks forward to completing the transition of analysts and investigators to "Safety Investigators."

Conclusion

In 1997, the TSB began the process to integrate the safety deficiency analysis function with the investigation function. To support this integration and to ensure that investigators and analysts acquired the skills of both functions, the TSB developed an integrated methodology and contracted the development of a multi-media-based ISIM training course. The training program was launched in late summer of 1999 and will be completed by year's end. Once investigators and analysts are trained in ISIM, the TSB will have reached its goal of having integrated occurrence investigations conducted by fully qualified "TSB Safety Investigators".

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Paper 9928

Ray Howe

Rail Accident Investigation
Messages for the Millennium

Publisher
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Ray Howe

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 trying to adapt his bowls skills to curling in Canada amongst his relaxations.

1999 International Rail Safety Conference

managing safety in a changing world

Rail Accident Investigation – Messages for the Millennium.

R E (Ray) Howe, Rail Accident Investigator, Transport Accident Investigation Commission, New Zealand.

Paper to be presented at Banff, Canada, October 1999.

1. Introduction

When managing safety in a changing world the nature of the changes, and the rate of introduction, requires new responses to new challenges. However, there is a need to ensure proven traditional systems for managing safety are maintained in a controlled manner which ensures overall safety standards are not compromised.

This paper reviews the 17 rail investigations completed by the commission over the last year with particular regard to how lessons learnt may help in managing safety into the new millennium.

Each occurrence is summarised in Section 2, and will be expanded upon as necessary using power point presentation. Following each summary key underlying issues which it is considered have general application have been highlighted. These key issues are drawn together in Section 3 and some messages to carry forward into the new millennium are suggested.

2. Occurrences during the year

2.1 98-103[1], collision with transition head

A suburban passenger service collided with a transition head which had fallen from the locomotive cowcatcher. Damage to the underside of the locomotive resulted in a 3000 litre diesel fuel spillage.

The cause of the collision was a transition head becoming displaced in transit due to inadequate stowage details.

Safety deficiencies identified were:

- The lack of adequate investigation of the work necessary to convert overseas rolling stock for New Zealand coupling requirements.
- The failure of the safety system to prevent unauthorised modification of rolling stock.

The suitability of the fixing detail for stowage of transition heads on cowcatchers was identified as a safety issue.

<u>*key issue:*</u> • unauthorised modifications

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[1] These are the occurrence numbers allocated which can be used to obtain a full copy of the report if desired, or to access information on the Commission's website, www taic.org nz.

2.2 Report 98-105, derailment due to displaced load

A displaced stack of platform containers on an express freight train struck a through-truss bridge. As a result of the collision the train parted, six wagons were derailed, and major damage to the bridge occurred when five wagons and various loads concertinaed.

The cause of the collision was the movement of inadequately restrained stacked platform containers. Safety issues identified were:

- the serviceability and uniformity of integral interlocking devices fitted to platform containers;
- the standards for transporting stacked platform containers internationally; and the understanding of and compliance with requirements for transporting stacked platform containers by rail.

key issues:
- adequacy of standards and procedures
- lack of understanding of safety requirements by staff involved
- unauthorised modifications

2.3 Report 98-106, collision with displaced load

A passenger express struck a displaced load on an express freight train which was berthed in a passing loop. There were no injuries. The passenger train suffered superficial damage to the locomotive and carriages. Safety deficiencies identified were:

- the lack of appreciation of correct load securing requirements
- insufficient training of staff involved in loading
- the lack of adequate standards and procedures to prevent the use of unsuitable restraining devices.

key issues:
- lack of understanding of safety requirements by staff involved
- insufficient training
- failure to detect repeated non-compliances

2.4 Report 98-107, wrong line running

An express freight train was mistakenly routed on to the wrong main. This operating irregularity was not responded to appropriately and the train was permitted to continue running in the down direction on the up main. Safety issues identified were the training and experience of staff used for relief duties in the signal box, the acceptance by locomotive running staff of inappropriate authorisation and the potential hazard to road traffic at level crossings during the wrong line running

key issues
- failure to maintain the level of knowledge of staff required to carry out relief duties
- lack of application of crew resource management principles
- reluctance to report irregularities

2.5 Report 98-108, collision between passenger carriages and the detached locomotive

The carriages of a vintage steam train ran away down a grade and collided with the locomotive which had been detached for coaling during a scheduled stop. One minor injury occurred to a passenger as a result of the low-speed collision.

Safety issues identified were the suitability of the rules for detachment of engines, compliance with the rules, and the suitability of the procedures for on the job training of the voluntary staff.

key issues:
- adequacy of procedures
- insufficient training
- failure to detect repeated non-compliances

2.6 Report 98-109, near collision

An express freight train conveying six empty wagons was stopped by a member of the public waving a torch just ahead of a main line blockage caused by wagons in an adjacent siding which had run away and derailed fouling the main line. The safety issues identified were the lack of adequate standards and procedures in place to protect the main line from possible wagon runaways on steeply graded sidings, and the lack of adequate procedures to identify recurring problems and initiate appropriate follow up action.

key issues:
- adequacy of procedures
- pro-active follow up of minor operating irregularities to avoid major incidents or accidents

2.7 Report 98-110, derailment

An express passenger train derailed at slow speed when the rear of the up train was routed to the down main when motorised points moved under the train. There were no injuries.

Causal factors were non-compliances with intended procedures for points operation. Safety issues identified were the suitability of those procedures and the effectiveness of compliance monitoring.

key issues:
- adequacy of procedures
- failure to detect repeated non-compliances

2.8 Report 98-111, collision with pedestrian

A group of secondary school students were crossing a rail yard. A cyclist in the group dismounted to cross the rails, and while pushing his bicycle fell in front of a diesel multiple unit passenger train. The youth received serious injuries requiring amputation of one leg.

The safety issue identified was the established trespass in the area, despite the presence of a pedestrian overbridge.

key issue:
- established trespass being accepted as the norm

2.9 Report 98-112, log fall from wagon

A number of 3.7 m long logs fell from a rake of loaded log wagons while being shunted following an arrival.

The loss of load occurred because the logs were not adequately restrained by the cradle supports at either end. A safety issue identified was the lack of suitable procedures for securing 3.7 m logs on standard log wagons.

key issue. • adequacy of procedures

2.10 Report 98-114, near collision

An on-track maintenance group had just finished packing up their two hi-rail vehicles for off-tracking when they noticed a track evaluation car approaching. The ganger managed to contact the locomotive engineer using the train control radio and the car was brought to a stop clear of the hi-rail vehicles. The cause of the near collision was the drawing of a maintenance occupation on the train control diagram approximately 10 km south of its actual location. The safety deficiency identified was the lack of procedures to ensure that movements and occupations were correctly plotted on the train control diagram.

key issue: • adequacy of procedures

2.11 Report 98-115, runaway wagons

An express freight train conveying 18 empty coal wagons was stopped on the down main adjacent to a marshalling yard to allow the locomotives to be detached for servicing. A few minutes after the locomotives had cut off, the wagons started moving down the grade. In the course of their movement the wagons crossed two protected level crossings where insufficient warning time for road traffic was provided. The safety issues identified were non-compliance with the existing rules for securing detached vehicles and the practice of leaving detached wagons on the main line.

key issue. • failure to detect repeated non-compliances

2.12 Report 98-116, derailment

A passenger train comprising 4 Electric Multiple Unit cars derailed while negotiating a turnout from single line to double line. The 2 leading cars were derailed. There were no injuries. A worn switch rail on the turnout which permitted 2 bogies to be directed to the up main as the remainder of the train followed the intended route to the down main caused the derailment. A safety issue identified was the failure of the inspection regime to detect and correct the worn switch before it reached derailment condition.

key issue • adequacy of procedures

2.13 Report 98-119, train movement while passenger alighting

The sliding doors on a commuter train closed on a child in a pushchair as the mother was endeavouring to lift the pushchair from the train to the platform at a planned stop. While attempts were being made to free the pushchair the train moved slowly forward before the doors were opened sufficiently to allow the pushchair to be freed. The safety issues identified were the possibility of diesel multiple units being able to move from rest without all doors being closed, and the lack of compliance with procedures laid down for passenger safety.

key issue: • failure to detect repeated non-compliances

2.14 Report 98-120, dragging brake gear

Dragging brake gear on a high speed freight wagon at the head of a passenger express train struck and damaged main line turnouts The train continued for a further 26 km before the locomotive engineer noted track ballast being thrown up by the dragging brake gear and stopped the train.

Dragging brake gear had the potential to damage facing turnouts to the extent that the points could move under a train and direct part of the train to a different route. Any such diversion of part of a passenger train had a high probability of leading to a serious derailment.

Safety deficiencies identified were the inadequacy of the brake rodding safety straps and the failure of the safety system to prevent or detect dragging brake gear creating a danger to crew and passenger safety.

key issue: • security of brake rodding

2.15 Report 99-102, track warrant overrun

An express freight overran its limit without a valid track warrant and continued approximately 18 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 warrant was issued and a relief locomotive engineer completed the remainder of the journey. The overrun resulted from the locomotive engineer failing to recognise the limit of his track warrant.

key issue: • lack of application of crew resource management principles

2.16 Report 99-104, train departed while passengers were loading their gear into the van

A passenger service departed from a rural station while a scout party and an adult passenger were still loading their gear into the van. Three scouts were left on the platform and a fourth scout and the adult travelled to the next station in the unlit van. The scouts were at risk as they either alighted from or attempted to board the moving train during departure. The guard was unaware of the passengers' presence in the van. The incident occurred due to a failure to ensure passenger safety prior to the departure of the train. The safety issue identified was the lack of adequate procedures to ensure passenger safety prior to giving right of way.

key issue: • adequacy of procedures

2.17 Report 99-106, fumes in passenger compartments,

Due to partially locked-on brakes on the fifth car of the six-car consist of an electric multiple unit commuter service, acrid fumes given off from the composition brake blocks entered the three rear cars. The resulting strong smelling "haze" caused discomfort and anxiety to passengers as the train passed through two tunnels before stopping at the next station.

A safety issue identified was the lack of appropriate training and certification of part-time train staff in responding to foreseeable operating irregularities.

key issue: • adequacy of training of part-time staff

A feature of the year reviewed is the number of incidents investigated (16), compared to one accident involving trespass. This reflects both the inherent safety of rail transport in New Zealand and the Commission's desire to learn from incidents and thus avoid accidents.

3. Key issues identified

The 17 investigations identified 28 key issues, many of which were common to more than one investigation. The key issues identified can be grouped under 7 main headings:

	Number of investigations which identified this issue
Adequacy of standards and procedures	11
Adequacy of training	6
Failure to detect repeated non-compliance	5
Lack of application of crew resource management principles (including reluctance to report irregularities)	4
Accepted trespass	1
Proactive follow-up of minor incidents to avoid possible major incidents or accidents	1

Table 1

It is interesting to note that in 11 of the 17 investigations an observer could be excused for concluding that the cause was human error, and that human error played a major part in a further four occurrences. Human behaviour is fallible; the challenge to investigators is to determine the underlying factors which have weakened defences and resulted in too much reliance being placed on the human factor.

It would be unwise to read too much into a small sample of 17 investigations. However, Table 1 does highlight the particular importance of specific aspects of safety systems and prompts the following "messages for the millennium".

3.1 Standards and Procedures

This is an essential part of any safety system, and in New Zealand, as worldwide, it has received particular attention as rail transport has undergone radical changes, including major staff reductions, to remain competitive and viable.

There is a continuing challenge to ensure that such documentation is sufficient, clearly presented, and disseminated to, and understood by, those for whom it is intended.

The days when it was sufficient to have a rule or requirement buried in a "user-unfriendly" document are gone. Rail operators in general, and New Zealand operators in particular, have made major improvements in this area but further improvements are still needed to ensure the increased demands on the fewer multi-skilled staff involved are supported by clear, concise, unambiguous and available requirements.

3.2 Training

The understanding of job requirements is linked directly to training. Despite the strong commitment to training within the New Zealand rail industry, adequacy of training features as a factor in 35% of the occurrences investigated. As reorganisations occur in the rail industry worldwide, and staff numbers reduce as operators "right-size", it is important to ensure that the demands of training, which may well increase short-term, are recognised and addressed.

3.3 Failure to detect repeated non-compliances

This issue was present in approximately 30% of cases investigated. While non-compliance due to lapses will always be a potential weakness, repeated non-compliance may indicate an underlying culture. There are a number of reasons why repeated non-compliance may occur, including:

- an unnecessary requirement

- a necessary requirement which is physically difficult or operationally restrictive, and therefore ignored
- a requirement that is not understood

Repeated non-compliance has the potential to erode the confidence of staff in the safety system, and their role in particular, and it is important that it is detected and addressed at an early stage.

3.4 Lack of crew resource management training

The marine and air industries have actively promoted forms of crew resource management training for many years. The rail industry does not appear to have embraced this concept in a formal manner to the same extent, as evidenced by the New Zealand experience and recent National Transportation Safety Board recommendations in the USA. Specific training that addresses:

- crew proficiency,
- situational awareness,
- effective communication and teamwork,
- strategies for appropriately challenging and questioning authority,

would encourage an interdependent safety culture and thus provide more effective defences to possible accidents.

4. Conclusion

By world standards, New Zealand is a small, isolated and self-sufficient rail system, relying heavily on conventional technology, but incorporating innovative adaptations of new concepts to meet New Zealand demands. Although small, it is a recognised leader in involving and utilising its most important resource, people, in safe and cost-effective operations. The messages I suggest for the new millennium relate to the continued need for organisational commitment to support less staff as they face the challenge of operating safely into the 21st century, be they in New Zealand or elsewhere in the rail industry.

1999 BANFF

19 October - 22 October 1999
Banff Springs Hotel, Banff National Park, Alberta, Canada

Paper 9929

Johan de Villiers
Ray Howe

Plenary Session "C"
Incident Notification - Cooperate or Regulate
(2 Papers)

Note: Two papers formed the keynote discussion papers for Plenary Session "C". 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

1999 International Rail Safety Conference, Banff

Ray Howe

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 trying to adapt his bowls skills to curling in Canada amongst his relaxations.

[redacted]

CURRICULUM VITAE SUMMARY

FOR

JOHAN DE VILLIERS

Johan graduated with the degrees B.Sc.B.Eng. (Mechanical) at the University of Stellenbosch in 1965.

He started his engineering career with the South African Railways and Harbours immediately after graduation and worked in various divisions of the railway and harbours organistation.

Experience was gained in the maintenance of rolling stock and the manufacture of new rolling stock and of specialised rail infrastructure such as the high-speed turnouts used on the coal export line. He also worked as an engineer in the foundry on the mass production of cast iron items and the South African harbours in the design and building of new harbour craft.

He experienced the change from a Government managed railway to a commercial entity while working as Manager in Train Operations and later in Risk Management.

Presently he is in the fortunate position to put both his Risk Management and Train Operations experience into practice in a newly created department "Rail Risk and Quality". He is now responsible for Train Working Rules (Development, Implementation and Maintenance), Accident investigations, Safety management, Dangerous Materials Transport, Environmental management and Quality process development and implementation.

[redacted]

1999 International Rail Safety Conference

Plenary Session C

"Incident Notification – Cooperate or Regulate"

Joint presenters:	R. Howe	New Zealand
	J. de Villiers	South Africa

The session will be in two parts:

Part 1 Incident reporting, classification and logging.

Consideration of an operators role (based on a paper by J de Villiers on Spoornets system attached).

Part 2 The notification process to regulator/investigator. (based on the attached summary notes prepared by R. Howe)

SPOORNET

INCIDENT REPORTING, CLASSIFICATION AND LOGGING

Introduction

The present restructuring of Spoornet creates opportunities to redesign many of the outdated processes

All regional offices have been closed and the management of Spoornet is now centralised in Johannesburg. The philosophy is centralised planning and management and decentralised execution

Many of Spoornet's train control systems are still controlled from a local control office. This left the door open for local decision making especially as far as incident information management is concerned Incidents could be "hidden" by simply not reporting the happening A "Zero tolerance" approach was adopted that basically said that no employee has the authority/right not to report an incident irrespective of the type or nature of the incident, the consequence or who/what caused it or who/what were involved.

The Process:- Reporting

A Mainframe system called Rimas (Risk information management system) was developed and is presently in the process of being implemented.

The incident might happen anywhere on the infrastructure (22 000 route Km's and yards) and the train driver or any other employee will report it to the local Yard Planner or Centralised Traffice Control office.

The basic information will be recorded i.e.:-

- Train no
- Train Driver details or details of other involved employees.
- Place, time, date
- Drivers perception of what happened
- Warnings to other operators/drivers

This is logged directly on the first screen of the Rimas system.

The Joint Operations Office (JOO) in Johannesburg will receive all the first screen logged incidents

Screen

REGISTER INCIDENT

Incident Date : ________________ **Time :** ________________
Reported Date : ________________ **Time :** ________________

Route : ________________ x **Zone :** ________________ x **Ops Office :** ________ x
Location : ________________________________

Env Imp: __ **(Y/N) Hazmat ind:**__ **(Y/N) Act 85/Section 24:** __ **(Y/N) Alirt No:**__
Train: ____________ **Wagon:** __________ **Loco :** ________ **Container :** __________

Reporter's Employee No : ________________ **x**

Surname: ________________________ **x Tel no:** ________________________

Description :

Press ENTER To Register An Incident, Press PF3 To Exit

Figure I

On a daily basis the collected information is presented to a group of knowledgeable employees from all the affected disciplines. They will view and decide on an immediate action plan based on the information collected over the previous 24 hours.

This group is called the "Clearing house" and they decide on:-

- Who will take immediate action on every reported incident i.e. wagon/axle failure to the wagon maintenance department etc etc (This is not emergency response action.)

- What following actions might be necessary in terms of further investigations or more information required etc.

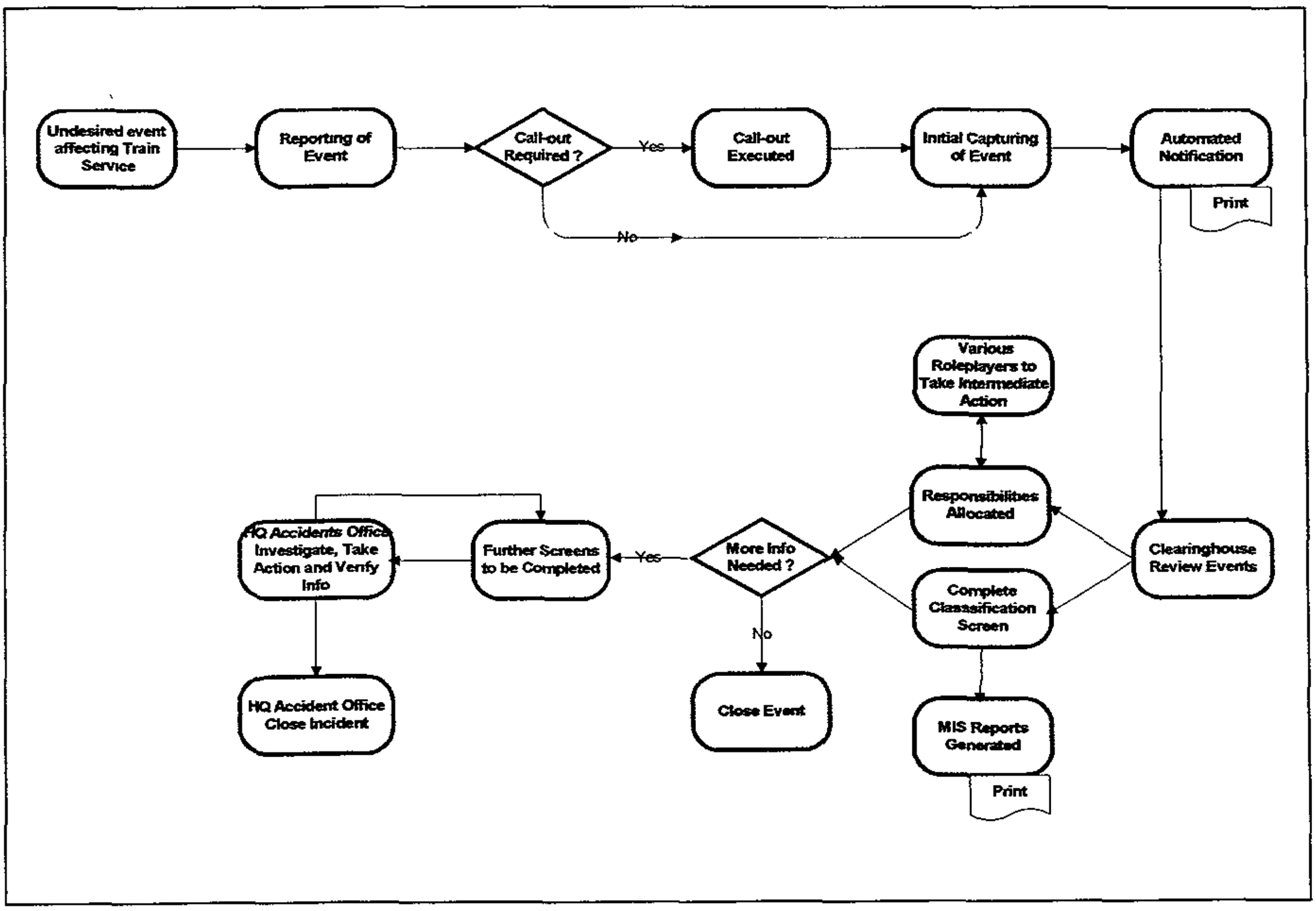
- What the longer term consequences from the incident might be and how best to manage it and then to decide on the accountable party/parties to accept responsibility to execute the decisions.

An experienced "Clearing house" should be able to deal with the 200 - 250 daily reports within 45 to 60 minutes.

Figure II shows the incident reporting and capturing process in a flow diagram form

Figure II

INCIDENT REPORTING/CAPUTRING PROCESS



The Process:- Classification and Logging

Once the "Clearing house" decided on responsibilities the classification and logging process commences.

Logging is done from read only code descriptions

The first read-only code is the "Where" code It forces the decision on one of fourteen options.

Example - Where (did this incident happen?)

Option.-
- Branch line
- Loco depot
- Wagon depot
- Mainline
- Harbour
- etc

Once the "Where" code is selected the "Classification" codes screen comes up.

Classification will include:-
- collision
- derailments
- asset damage
- fire
- delay
- Customer Service Deviation
- etc.

The classification screens are followed by the "reason" codes.

Reason codes might be -
- Animal(s) killed
- Communication failure
- Signal failure
- Staff deviation
- Operational failure
- Level crossing equipment failure
- etc.

Reason classifications are followed by the "Cause" table

Examples are:-

- Hot axle
- Broken rail
- Blown signal lamp
- Broken OHT wire
- etc.

"Sub causes" are the last read only table -

- Roller bearing
- overheating
- lack of maintenance
- wash-a-ways
- sabotage/theft
- etc.

Examples of results from the system:-

The straight line process of .-

Incident → classification → reason → cause → subcause is deviated from only in the case of a collision where a subscreen "collision with" surfaces and requires the fill in of details of the second party involved in the collision

Incident → classification → collision with → reason → cause → subcause

Figure III and IV are real life examples chosen to illustrate the process and the type of information that will be captured in the logging of the detailed information.

Figure III

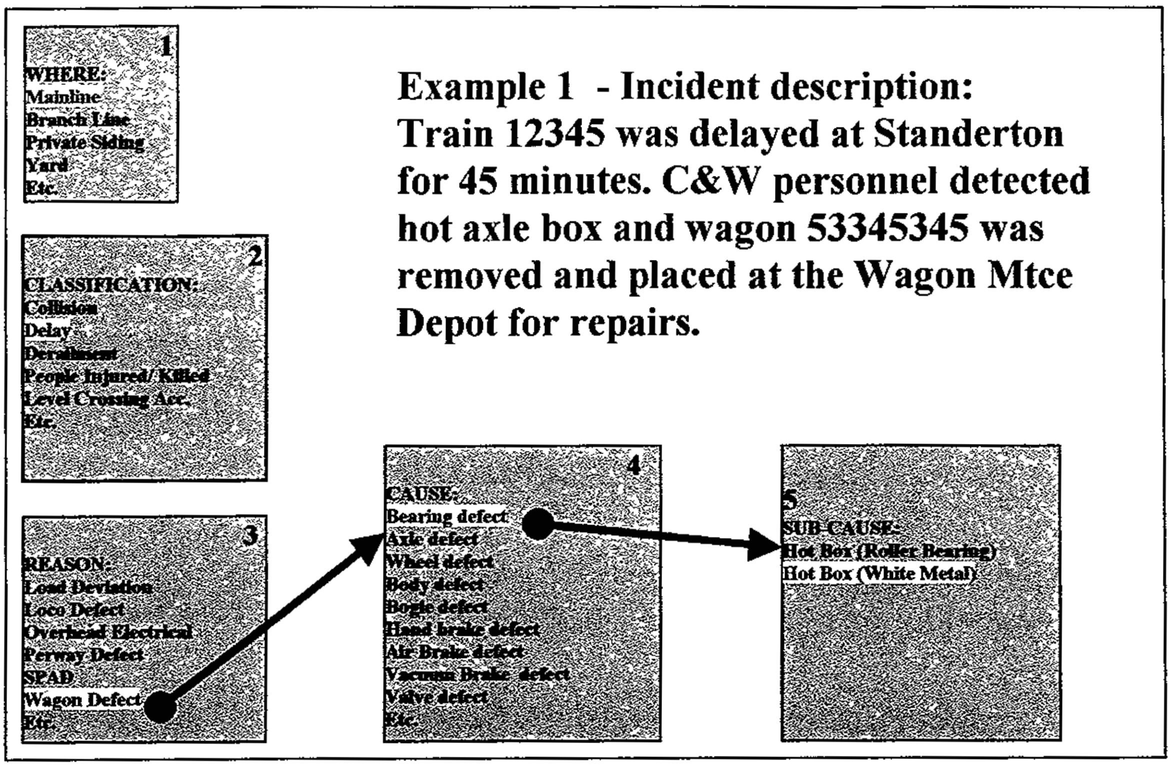
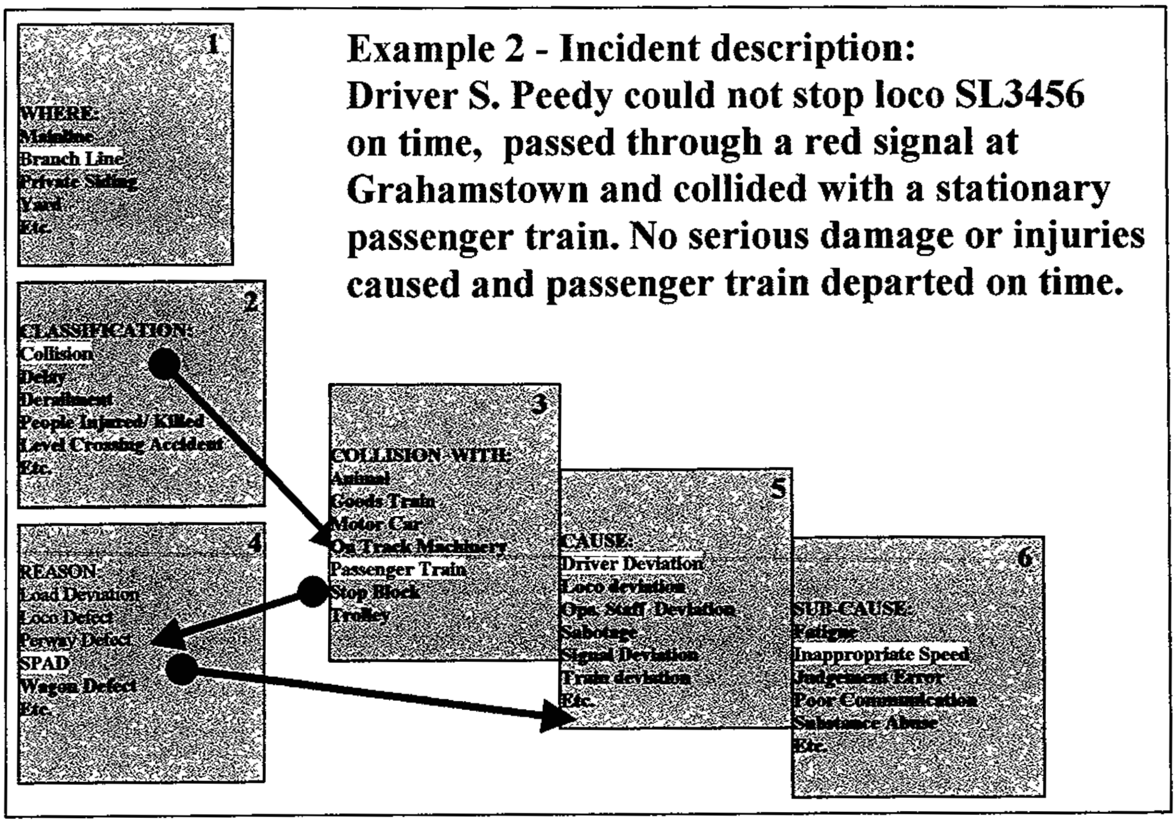


Figure IV



Definitions:-

From the above descriptions and the examples one can conclude as follows.-

Where.- The physical location (km point)(Where can also mean . Main line, Yard, Private Siding, etc.)
Incident classification refers to the last identifiable happening in the series of events during the occurrence of an incident.
Reason:- The identified medium that is involved in the cause of the incident.
Causes - The element(s) in the medium that failed.
Sub-cause:- Clarification of the element(s)/failure(s).
Collide with what:- clarification/description of the 2nd party involved in a collision

Questions:-

Spoornet recently participated in benchmarking exercises of different railways from all over the world.

With every one of these benchmarking exercises it seems as if accidents and incidents are viewed through different pairs of glasses. It is only with great difficulty that one can devise means to compare information.

We are living in the "global village" the nature, type and accuracy of information as well as the compatibility of the content is becoming more and more important in the rail transport business.

Is it not time that this conference influence the railway industry to decide on a standardized way of incident classification?

It should ease our mutual understanding of each other, facilitate companies in performance management and measurement and might even contribute to enhance railway business.

Specific questions:-

- Is the Spoornet way of doing incident classification in line with what the more developed railways are doing?
- Where can we improve our system?
- What flaws have we, not knowing any better, built into the system

- "cause" or "sub-cause". It is thus not necessary to dig down to "sub-cause" on every incident The "dig down" process is expensive, labour intensive and time consuming. It will be nice to receive advise on the following -

  Is it acceptable practice to define a specified few groups of incidents where analysist to the level of sub-causes are required or

  Is it standard practice to examine every incident in depth

~"~

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E-Mail	**:**	Johand5@transnet co za

Incident notification – co-operate or regulate

- Better to investigate and learn from incidents than accidents
- In the interests of all parties to over notify rather than under notify
- NZ based on co-operation – no regulation
- Memorandums of understanding clarify intent of the Act(s)
- What practices are adopted elsewhere?

[redacted]

Notification of accidents or incidents in NZ

- operators to LTSA
- LTSA to TAIC
- the 1996 Amendments to the TAIC Act
  a) TAIC not restricted to LTSA formal notification
  b) the mandatory requirement to investigate all fatal accidents removed

Notification procedures

- timeliness
  a) accidents – generally achieved
  b) incidents – not achieving to optimum level
- factors affecting timely incident notification
  a) indirect notification
  b) common understanding of what constitutes an incident
- advantages of a wider interpretation of what constitutes an incident
- over-notification versus over-regulation
- rails relationship to other modes

Who should the operator notify incidents to?

(a) The regulator

Pros?

Cons?

(b) The investigator

Pros?

Cons?

International Rail Safety Conference

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Banff Springs Hotel, Banff National Park, Alberta, Canada

Paper 9930

Gerd-Erich Lŏwer

Aspects of stabilising and developing safety in a railway system, An enhanced approach to railway safety

Publisher
2000 International Rail Safety Conference

Biography Mr. Loewer

Name:	Loewer
First name:	Gerd-Erich
Date of birth:	15/08/43
Title:	Mr.
Position:	Head of Safety Department DB Netz AG and Safety Commissioner DB AG

Position in recent years:

- Project engineer in different signal & telecom projects
- Several years as assistant to the Chief Signal & Telecom Engineer at the DB headquarter in Frankfurt
- Several years as senior engineer and head of the Signal & Telecom Department at the regional headquarter Frankfurt
- Since 1997 head of the safety department DB Netz AG and Safety Commissioner DB AG

Aspects of stabilising and developing safety in a railway system,

an enhanced approach to railway safety

by Mr. Gerd-Erich Löwer
Safety Commissioner DB AG

1999 International Rail Safety Conference
Bannff, Canada

Instruction for the ÜSB-commission issued by the chairman of the DB AG Mr. Dr. Ludewig

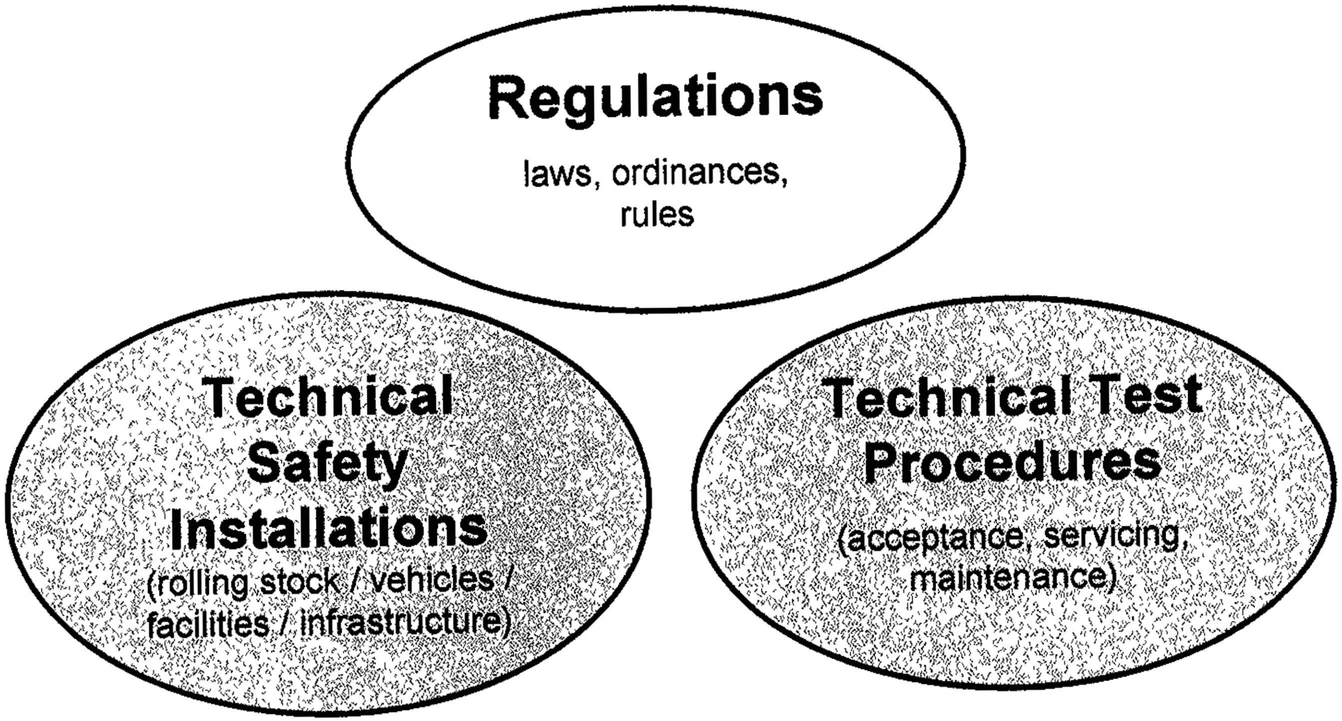
The commission has to investigate all safety-related aspects of the entire railway system.

- The commission has to develop solutions for improving safety of the railway-system

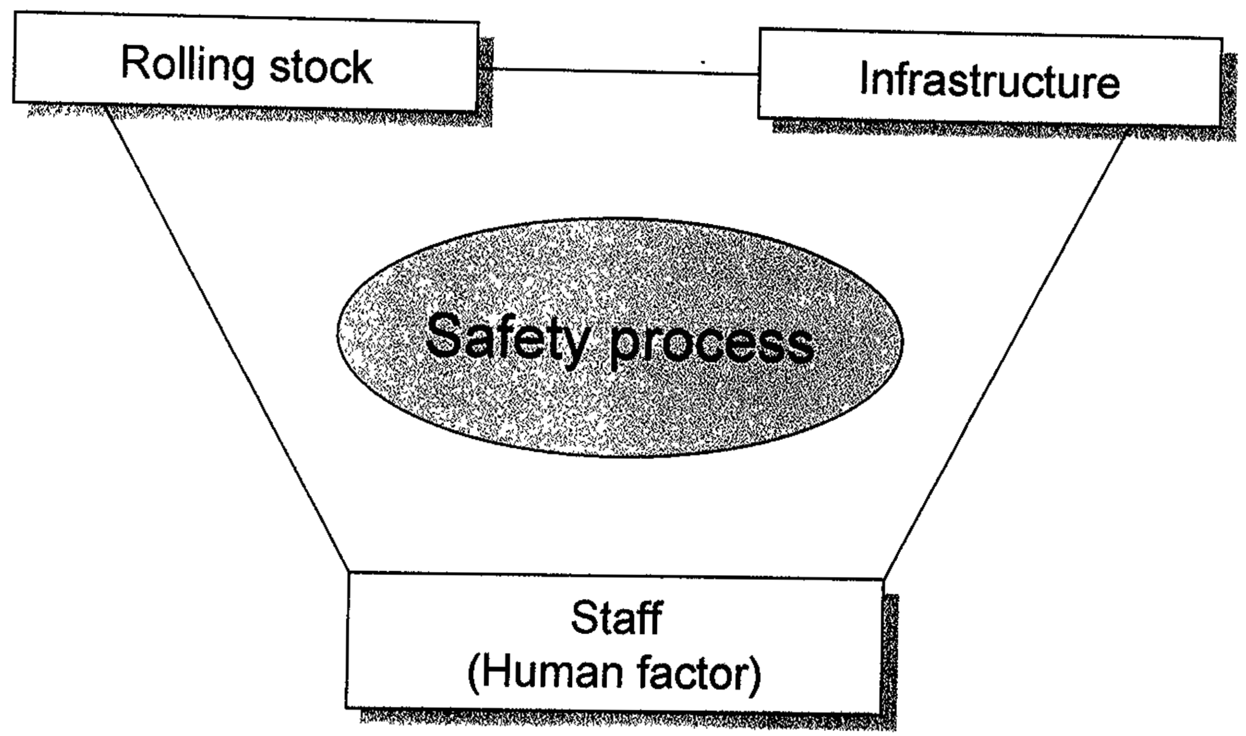
  especially

- for operating / maintenance / regulations and
- for further development of the DB AG high-speed-system

Basic Safety System



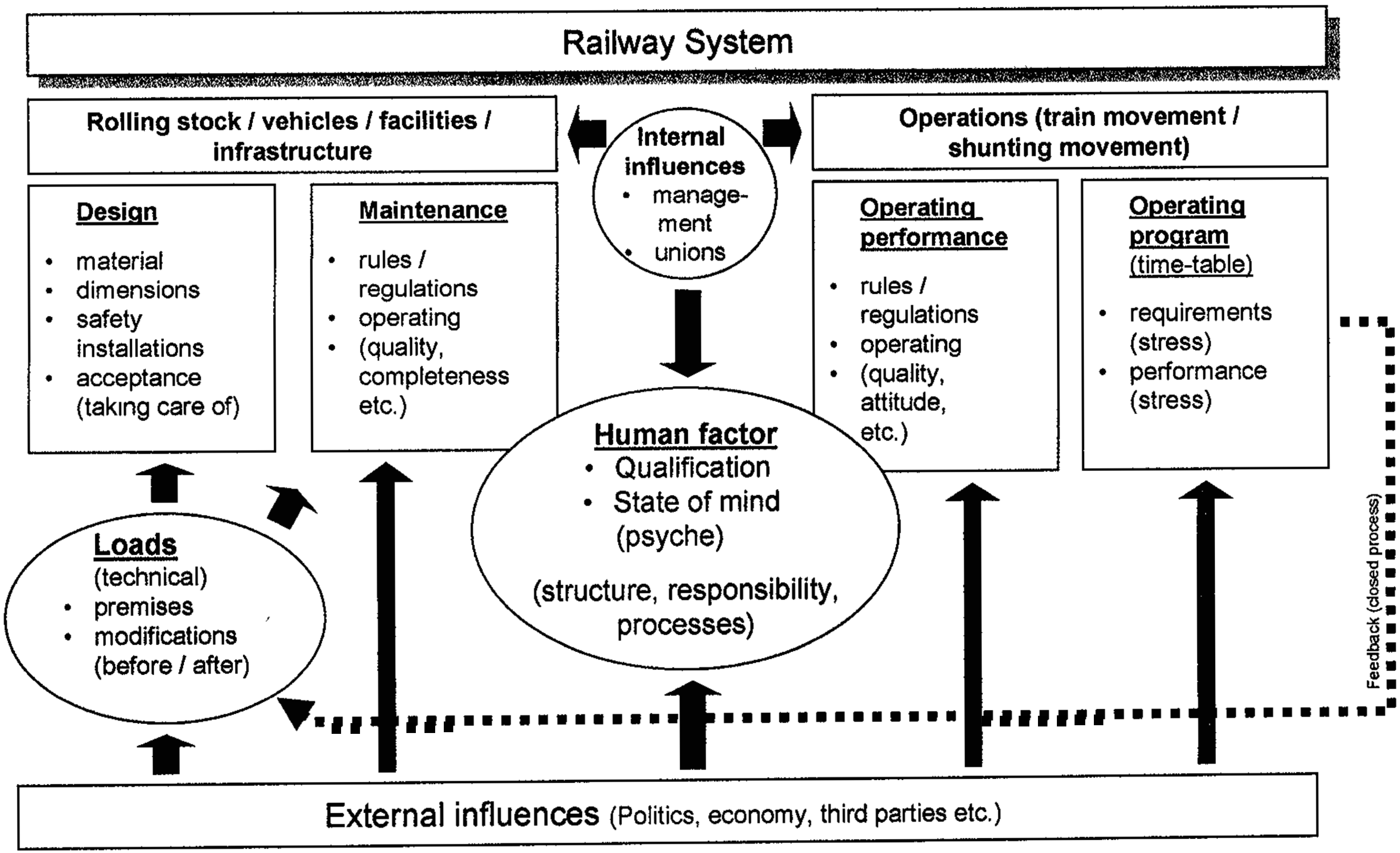
Enhanced approach to safety in railway operations

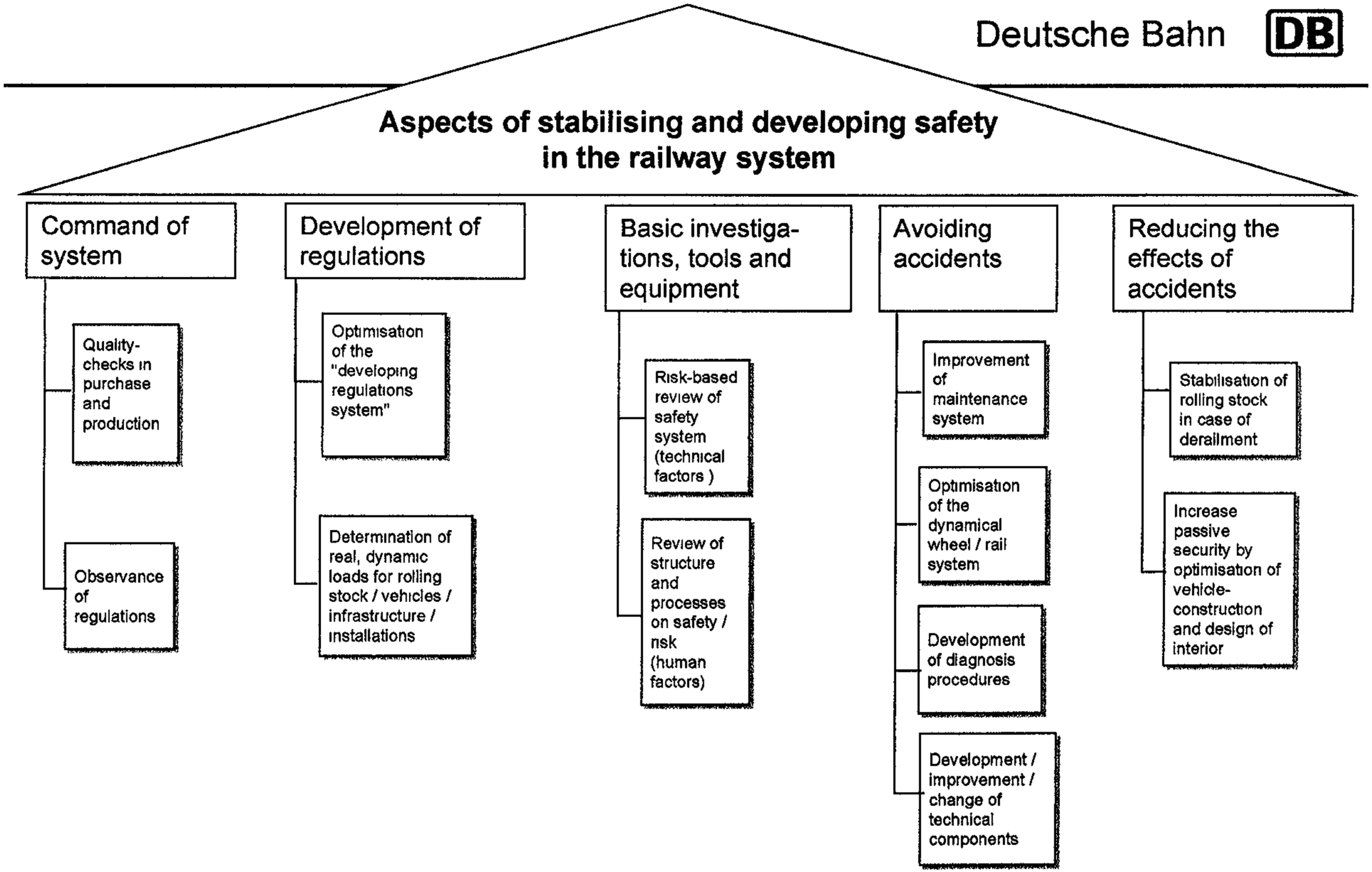


Railway Safety Review

- **System**
  - Risk-based review of safety system (technical factors)
  - Review of structure and processes on safety / risk (human factor)
- **Certificates**
  - Review of "old" certificates (bogies, wheel-sets)
  - Determination of actual, dynamic loads for rolling stock and infrastructure (high-frequency, single disturbances)
- **Purchasing**
  - Review of quality management within the purchasing process
  - FMEA for all new rolling stock / vehicles (industry)
- **Maintenance**
  - Review of maintenance systems
  - Measurements to avoid offset of wheels
  - Optimisation of inspection intervals
- **Diagnosis**
  - Improvement of diagnosis procedures
    - bogies
    - ultrasonic
  - Installation of vertical wheel force measurement equipment along the tracks
- **Optimisation Wheel / Rail system**
  - Embedding of soft rail pads on high-speed-tracks
  - Optimisation of wheel / rail embedding-parameters
- **Reducing effects of accidents**
  - Avoiding turnouts in front of bridges / tunnels
  - Measures for stabilisation in case of derailment
- **Review of regulations / rules**
  - Review of operational and technical regulations under aspects of completeness, clear and straight orders, efficiency of handling

Review activities (Start 1998)


Railway System
Rolling stock / vehicles / facilities / infrastructure
Internal influences
• manage-ment
• unions
Operations (train movement / shunting movement)
Design
• material
• dimensions
• safety installations
• acceptance (taking care of)
Maintenance
• rules / regulations
• operating
• (quality, completeness etc.)
Operating performance
• rules / regulations
• operating
• (quality, attitude, etc.)
Operating program (time-table)
• requirements (stress)
• performance (stress)
Human factor
• Qualification
• State of mind (psyche)
(structure, responsibility, processes)
Loads
(technical)
• premises
• modifications (before / after)
Feedback (closed process)
External influences (Politics, economy, third parties etc.)


Aspects of stabilising and developing safety in the railway system
Command of system
Quality-checks in purchase and production
Observance of regulations
Development of regulations
Optimisation of the "developing regulations system"
Determination of real, dynamic loads for rolling stock / vehicles / infrastructure / installations
Basic investigations, tools and equipment
Risk-based review of safety system (technical factors)
Review of structure and processes on safety / risk (human factors)
Avoiding accidents
Improvement of maintenance system
Optimisation of the dynamical wheel / rail system
Development of diagnosis procedures
Development / improvement / change of technical components
Reducing the effects of accidents
Stabilisation of rolling stock in case of derailment
Increase passive security by optimisation of vehicle-construction and design of interior

Preventive measures
Part 1

- Replacing the rubber spring loaded wheels of ICE 1 into monobloc-wheels
- Ultrasonic checking of wheels in shorter distances (referred to distance covered)
- Introduction of vertical wheel force measurement equipment for monitoring the dynamic of running gear ICE (research project)
- Reprofiling / change of wheels to guarantee smooth running dependent from dynamic behaviour
- Improvement of the ultrasonic component of the ULM (pilot installation)
- Adaptation of track stiffness (new lines / renewed lines)

Preventive measures
Part 2

- Monitoring of line dimension especially avoiding of points / cross-overs before / on bridges e.g. adaptation of the design of the planned new lines Köln - Rhein / Main and Nürnberg - Ingolstadt - München
- FMEA for current development of rolling stock and quality safeguarding at development / construction at the manufacturer
- Co-operation with Lufthansa for comparing of the maintenance systems:

  ➪ dividing function technique / maintenance
  ➪ and implementation of the 4-eyes-principle by relevant tests / clearances incl. certification

Development safety system gear / track
Part 1

Deutsche Bahn DB

- Checking of burden collective because of changed operating conditions with feed-back to monitoring and construction (railway / manufacturer)

- Optimising correlation track / rolling stock (reduction dynamic burden)

- Suitability / safeguarding of quality of the material (manufacturer)

- Monitoring of dynamic reactions in trains (e.g. out-of-round wheels, damper)

- Monitoring of track condition (dynamic consequences of running)
- Detection of gears while running
- Revision of all rulebooks of maintenance, quality management rolling stock / track incl. list of faults general in the railway group
- Revision of testing of materials (non-destructive test with automation)

Development of safety system / safe process
Part 1

- Improvement of clarity for terms function / responsibility / contents incl. commitment
- Development mental safety culture
  - Open communication / unfalsified awareness reality
  - Prioritisation value
  - Training of unexpected situations under stress situations
  - Management rules (drawing up, keeping to, monitoring of, changing of)
- Including / continue safety relevant „functions“ (processes / responsibilities) by change of structure (continuity)

- Description new role manufacturer, certification authority, operator (certification new rolling stock / components and looking after measurements of maintenance)

- Internal controlling system for keeping of safety relevant functions of the maintenance technology

- Improving safety organisation on all levels: new structure for safety commissioner railway at group level and at companies

Analysis of the entire structure of DB AG under risk and safety / security aspects on all management levels

Actual situation:

To avoid any risk of system failure DB AG is actually faced by a couple of problems which demand for a specific risk-management:

For example:

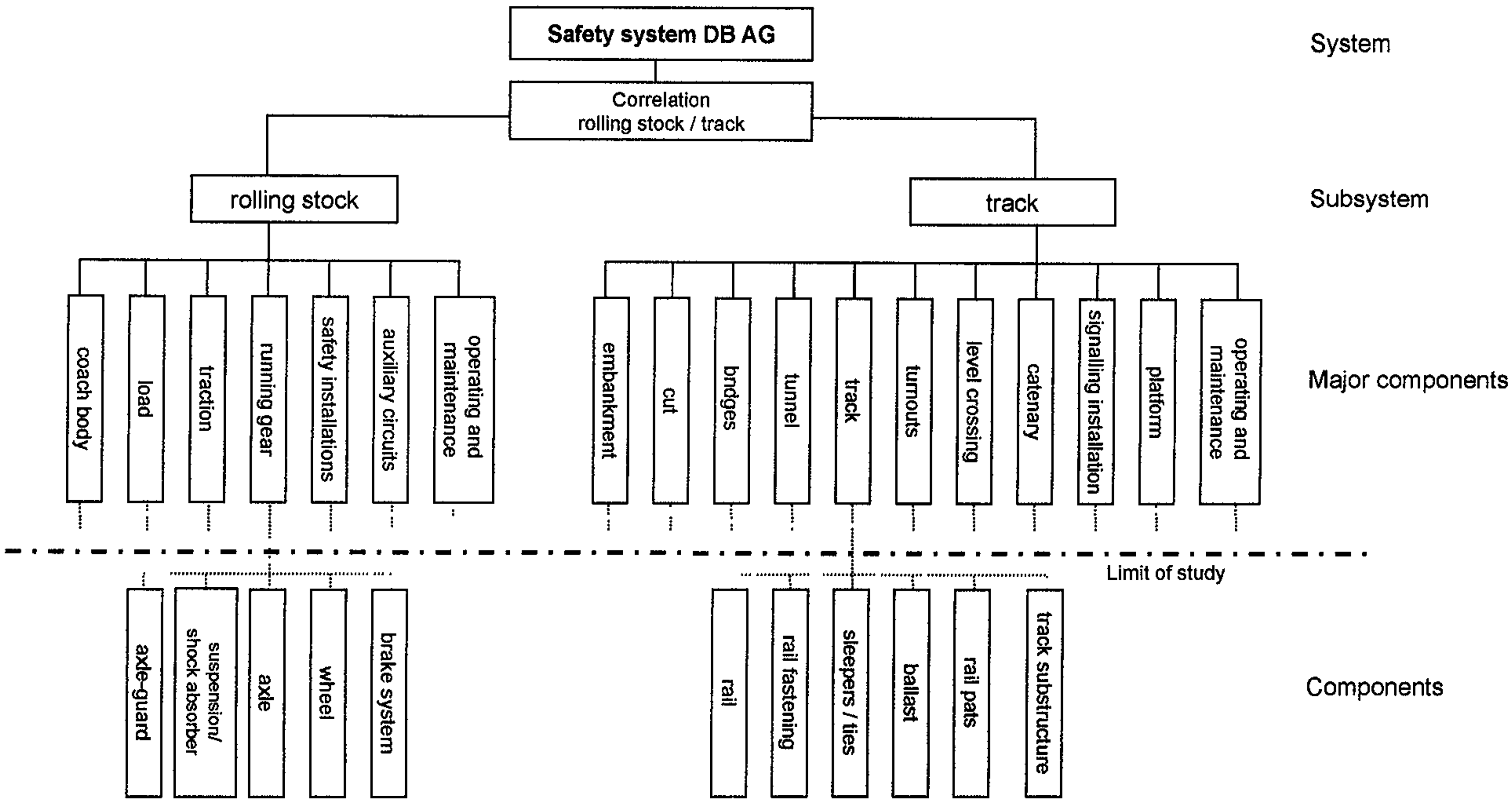
- Improving the safety-level even under increasing productivity of railroad staff
- Outsourcing of responsibility for safe products to third parties (industry)
- Total reorganisation
- Increasing efficiency of turnaround cycles for rolling stock
- Risk-based valuation of measurements
- Improving awareness of railroad staff for identifying risks

Other actions

- Comparison with the maintenance system of our national airline carrier Lufthansa
- As a first result realisation of an initial start-up program (10 major steps)
  - ⇨ Improvement of staff qualification
  - ⇨ New structure for regulations / rules and operational instructions
  - ⇨ Improvement of the existing maintenance program
- Setup of an project for continuos onboard diagnosis of running gear

Other actions
(partner: TÜV Energie- und Systemtechnik GmbH and DE-Consult)

Deutsche Bahn DB



Risk-based verification of the safety system

Project 1 System classification	Project 2 Quantified analysis of different crash scenarios	Project 3 Valuation of different risks
Partitioning into subsystems	Estimated probability of real and hyphotetical scenarios	Classification
Systematic valuation of all relevant input information	Valuation of the consequences of real and hyphotetical scenarios	Valuation
Elaboration of different scenarios		Identification of weak points / processes

General Target

Continuos supervision of the over-all railway process under following aspects

- stable working processes
- failures / disturbing functions
- level of actual loads
- actual level of comfort / wear

Target:

error-free, no malfunction, no increase in failure rate and practicable under operating conditions

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Paper 9931

Dr Jacob Kam
Ivan Lai

Safety assurance for new extension projects of the Hong Kong MTR Corporation

Publisher
2000 International Rail Safety Conference

Jacob Kam

Safety and Quality Manager
MTR Corporation, Hong Kong

Experience

Jacob Kam obtained his first degree in Civil Engineering from Southampton University, U.K. Before joining University College London as a Research Assistant, he was working for Ove Arup and Partners, the Consulting Engineers in Hong Kong and UK.

In 1987 Jacob became a lecturer in University College London where he also obtained his Doctorate in fatigue reliability and risk based management of structural inspection. His teaching and research specialism was in structural integrity of steel structures, fatigue of welds, non-destructive testing and risk based management of inspection and maintenance 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 techniques 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 new 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. The subjects included fatigue, non-destructive inspections, safety management, reliability assurance and risk management. He also has an MBA from Kingston Business School, U.K.

He was an active member of the I Mech E and the ASME. He was members of the I Mech E Offshore Divisional Committee (1988 - 95) and the ASME Offshore Mechanics and Arctic Engineering Conference Organising Standing Committee (1987 - 95). He was instrumental in several successful seminars and conferences organised by the Institutions. He is also a member of the organising committee for the Hong Kong Branch of the Institution of Occupational Safety and Health (IOSH).

Jacob received the Esso Centenary Award for outstanding young academics in 1989 and an Achievement Award from the ASME OMAE Division in 1992

Academic Qualifications

BSc (1st), Dip Eng, PhD, MBA (Distinction)

Professional Qualifications

CEng, MIMechE, MHKIE, RPE(mech), MIOSH, Eur Ing, MASME, M.AMBA

Ivan Lai

System Assurance Manager
MTR Corporation, Hong Kong

Experience

Ivan Lai obtained his first degree in Production Engineering in 1978 from Leeds Polytechnic, U.K. He joined Rank Xerox Engineering Group as a Reliability Engineer. His main duties included xerographic product development, reliability analysis and testing.

In mid 1984 he joined British Aerospace (Commercial Aircraft) Ltd and took part in the development of the BAe 146 Jet airliner, the BAe 125-1000 business jet and the BAe Turboprop. His principal accountabilities included conducting system safety assessments on safety critical aircraft systems, performing maintenance logic analyses to establish certification maintenance requirements with particular emphasis on safety related maintenance tasks, assessing acceptability of system deficiencies on aircraft for passenger flights, and liasing with national airworthiness authorities on matters related to airworthiness requirements, aircraft type certification and modification approval. By 1991 he was the Reliability Manager of the Safety and Certification Department.

He`returned to Hong Kong in early 1993. After working as a quality management consultant with Price Waterhouse for a short period, he joined the MTR Corporation in Hong Kong as the Quality Improvement & Reliability Manager. He was`responsible for developing a Reliability, Maintainability and Availability management framework for raiway asset replacement and renewal. In mid 1999 he became the System Assurance Manager and is now responsible for all sytsem assurance matters of the existing railway network and new MTR extensions.

Mr. Lai is a Chartered Engineer and a member of the Royal Aeronautical Society, U.K..

Academic Qualifications

BSc, BA, MSc

Professional Qualifications

CEng, MRAeS

1999 International Rail Safety Conference, 19 – 22 October 1999

SAFETY ASSURANCE FOR NEW EXTENSION PROJECTS OF THE HONG KONG MTR CORPORATION

Jacob Kam, Ivan Lai
MTR Corporation
MTR Tower,
Telford Plaza, Kowloon Bay
Hong Kong

ABSTRACT

The new 34-kilometre Airport Railway for Hong Kong was brought into operation by the MTR Corporation, on time and within budget, in the middle of 1998. The Airport Railway consists of two lines, the Airport Express Line and the Tung Chung Line, to connect the new Hong Kong International Airport and the Tung Chung new town with the existing transportation network of Hong Kong.

The total MTR network now comprises four mass transit railway lines and a dedicated Airport Express line The overall route length of the system is 77.2 kilometres and there are a total of 44 stations Passenger numbers per weekday for the mass transit lines total over 2.3 millions, making the network one of the most densely utilised railway systems in the world.

A comprehensive process known as the MTR Project System Assurance Process has been implemented to assure the operational safety and reliability of all new extensions. The key safety elements of the process include defined safety responsibilities, systematic identification, control, computer logging and tracking of hazards, quantified risk assessment, system safety modelling and a system safety report which documents the case for operational safety for the new line. The process also enables the Corporation to demonstrate the case for operational safety to the Hong Kong Railway Inspectorate for its agreement for opening the new lines to public passenger service.

This paper first describes the Project System Assurance Process, drawing relevant examples from the newly completed Airport Railway Project as appropriate. The paper then outlines the lessons learnt from the Airport Railway Project and how the process will be better integrated into the project management of future new Extension Projects.

1. INTRODUCTION

The Hong Kong MTR Corporation was established for the principal purpose of constructing and operating, on prudent commercial pnnciple, a mass transit railway system having regard to the reasonable public transport requirements of Hong Kong.

The Corporation currently operates five railway lines The overall route length of the system is 77 2 kilometres and there are a total of 44 stations. The three urban lines comprising the Kwun Tong Line, Tsuen Wan Line and Island Line commenced service between 1979 and 1989. The new 34-kilometre Airport Railway, which consists of the Airport Express Line (AEL) and the Tung Chung Line (TCL), came into operations in the middle of 1998. AEL is a dedicated high speed service linking Central District, Western Kowloon, Tsing Yi and the new Hong Kong International Airport at Chek Lap Kok. TCL is a domestic mass transit service linking the Central District, Western Kowloon, Tsing Yi and Tung Chung on Lantau Island. Figure 1 shows how the HK$35.1 billion Airport Railway connects the Hong Kong International Airport and the Tung Chung new town with the existmg MTR urban railway network.

TCL and the other three mass transit lines currently carry over 2.3 million passengers per weekday, making it the most densely utilised urban railway in the world. After one year of operation, AEL now carries about 30,000 passengers per day. This represents about a third of the total number of people travelling to and from the Hong Kong International Airport via all transport modes including cars. Trains on both lines operate at 135 km/hr, which is faster than any existing modes of transport available to date for intra-city transportation in Hong Kong. In July 1999 TCL and AEL achieved train service reliabilities, which are measured in terms of the number of passengers carried for each passenger delayed by 5 minutes (for TCL) and 10 minutes (for AEL) or more, of around 360.1 and 930.1 respectively.

In order to ensure that the Airport Railway is safe and reliable to operate, the Corporation implemented a Project System Assurance Process during the 43-month design and construction programme. The process consists of a senes of logical tasks aiming at the following objectives:

- Sufficient and adequate considerations have been given to the reliability, availability, maintainability and operational safety of the works during the project phase [*1,2*];
- All risks have been reduced to "As Low As Reasonably Practicable" (ALARP) [*3*];
- All requirements of the Hong Kong Railway Inspectorate have been met, and
- Cost effective reliability has been achieved

This paper will concentrate on the system safety elements of the assurance process. The key safety elements include defined safety responsibilities, systematic identification, control, computer logging and tracking of hazards, quantified risk assessment, system safety modelling and a system safety report which demonstrates the case for operational safety for the new line. These are further discussed below

2. THE MTR PROJECT SYSTEM ASSURANCE PROCESS

2.1 Organisation and Arrangement

The MTR Project Division has adopted a structured approach to safety management throughout the project phase. The safety management framework includes appropriate control processes, standards and defined safety responsibilities for key project team members. The Safety Responsibility Statements are signed by the individuals concerned to indicate their agreement and acceptance of the responsibilities for safety. The framework is set out in the MTR Project System Assurance Plan (called System Safety Plan in the Airport Railway project) and supplemented by Consultants' and Contractors' specific Safety and Reliability Plans.

The Corporate Safety Committee, chaired by the Operations Director, maintains a strategic overview of the system and processes throughout the project phase. The routine examination of major safety issues is conducted by one of its sub-committees, the Project Operational Safety Steering Committee (POSSC). POSSC is further supported by two safety working groups, which review and approve all significant hazards and their control measures identified for stations, depots, train, track and infrastructures during the project phase.

To ensure that the relevant interests of the Government departments are fully addressed in the system design and the respective approvals are obtained for construction and operations, the Safety and Security Co-ordinating Committee, the Trackside Fire Safety Committee and the Station Transport Integration Committee have been established to deal with safety, security and transport interchange related issues.

During the Pre-operational and Operational phases, the MTR Operations Division Safety Management System [*4*] steps into place to manage the operational hazards carried over from the project phase.

2.2 System Assurance Related High Level Project Documentation

Built on the Airport Railway experience, future MTR Extension Projects will have a hierarchy of documents that define the safety related objectives and requirements of the new railway lines.

(1) The Project Objectives provides the top-level definition of the new railway being designed and built. The Project Operational Safety Policy Statement gives unequivocal commitment to safety of the Project Director.

(2) The Service Requirement Document (SRD) details the operators' requirements for public passenger service. It defines how the train service, depot, Operation Control Centre and stations will operate safely under normal and abnormal circumstances. It also sets out the operational performance standards in the form of a Customer Service Requirements List.

(3) The Functional Requirements Manual (FRM) translates the service requirements into high level requirements of engineering systems and sub-systems, to enable further and more detailed functional specifications to be developed The Manual contains a series of functional statements, which together constitute a description of the system and an explanation of how it meets the Service Requirements. This Manual therefore provides to each discipline designer a context within which his particular design activities are set. Specific requirements for safety (ALARP and human factors) and factors to be considered for reliability, availability and maintainability (RAM) are also spelt out in the FRM.

(4) The Design Standards Manual (DSM) is organised by engineering discipline and contains lists of International / National /Industry standards to be used in design. Standards, design requirements, and practices specific to the MTR together with numeric data are also provided. This Manual also contains a list of the preferred techniques for use in different stages of the project for hazard identification, risk assessment and RAM analysis. The database structure for the Hazard Registration System that forms the key of the hazard control process throughout the life cycle of the railway, and specific information on the contents of system assurance plans and system assurance demonstration plans are also provided.

2.3 The System Assurance Process

The Project System Assurance Process ensures that the new extensions, as delivered for public passenger service, meet the Project Objectives and the performance requirements set out in the SRM and FRM for operational RAM and 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 Design, Construction, Testing and Operations stages is shown in Figure 2.

2.3.1 Design Stage

The key input in this stage is the Project Definition Documents (Operational Service Objectives for the Airport Railway) and specific "strategic design documents" such as the Station Fire Safety Report. They form the basis for formulation of the safety requirements of the Airport Railway systems

Based on the design standards and safety requirements given by MTR Corporation, the Detailed Design Consultants for the railway systems undertake Hazard Identification work (such as Design Safety Reviews) as an integral part of their design activities and provide details of potential hazards. Where necessary they also propose mitigation features to reduce the risks to a level that is As Low As Reasonably Practicable.

2.3.2 Construction Stage

The MTR Project Managers and Construction Managers oversee the processes undertaken by the Contractors to ensure that they adequately address the detailed design issues, and testing / commissioning requirements during the commissioning stage. Each Contractor is required to submit a System Assurance Plan and relevant System Assurance Analyses for MTR to approve All Contractors are required to address operational safety issues as well as ensuring that the construction phase has been safely controlled They must review all relevant hazards identified by the Corporation, identify new hazards, and undertake more detailed risk analyses at a depth that is commensurate with the complexity of their systems and the safety risks posed by their systems. They must also pay particular attention to the presence and mitigation of hazards that may affect the operation of the existing railway during the construction and installation phase of their systems.

2.3.3 Commissioning

The Commissioning requirements are defined with the Contractors for each contract. All safety related tests are identified to assure the required safety performance of the systems and their interfaces. As part of the commissioning activities, the Project Managers and Construction Managers verifiy the effectiveness of the hazard control measures which are implemented as per follow-up actions on residual hazards transferred to them during the design and construction stage. The Project System Assurance Section would also collect sample evidence of the implementation of the tests and checks during the commissioning stage.

During the final stage of commissioning, statutory inspections and testing are carried out with the statutory authorities to ensure compliance with local requirements and relevant safety standards. The statutory authorities conduct or attend the inspections of specific systems and equipment, for example, lift and escalator, smoke extraction system, water supply system, fire services installation, stations and ancillary buildings etc. The authorities will issue the relevant certificates and permits upon satisfactory completion of such inspections.

2.3.4 Trial Operations and Operational Phases

During the Trial Operations of the Airport Railway, the Operations Division was responsible for the overall operating and engineering aspects with support from the Project Division and Contractors. Exercises and drills were undertaken on various system failure and accident scenarios in order to confirm the performance and operations of key systems and hazard control measures. The exercises were also used to validate the effectiveness of the operational procedures well before revenue service (public passenger service), and to practise the co-ordination activities with the emergency services (for search and rescue) and the maintainer (for service recovery). During the large-scale evacuation exercises, information was collected from the participants on the effectiveness of public announcements, signage, lighting, actions of staff, personal feelings, evacuation environment and processes etc.

At the opening of the railway to revenue service, the Operations Division assumes the responsibility for managing the operational safety of the railway as defined in the Operations Safety Management System.

2.4 Systematic Identification and Control of Hazards

A systematic Hazard Identification and Control Process is applied throughout the design, construction and testing and commissioning stages by the MTR Design Team, MTR Construction Team, MTR Operations Team, Detailed Design Consultants, and Contractors during the various stages of the project Formalised hazard identification techniques such as Preliminary Hazard Analysis (PHA), Hazard and Operability (HAZOP) studies and Failure Modes, Effects and Criticality Analysis (FMECA) are used extensively to identify hazards that might potentially threaten the safety of staff and passengers involved in the operations of the new railway. This process facilitates the production of a comprehensive list of hazards. The hazards are categorised according their estimated occurrence frequencies and the severity of their consequences. There are four levels of risk, and measures to control hazards that fall into the highest three levels of risk are considered in detail by the Safety Working Groups.

All hazards and their resolutions are tracked by a database called the Project Hazard Registration System (HRS). This database has a standard structure so that the hazards requiring on-going control and / or monitoring during the Trial Operations and full Operations phase can be transferred directly into the Operations HRS. The Project HRS records the causes, effects and location of hazards and the status of the proposed mitigation measures. In addition it identifies for each hazard a hazard controller who is responsible for hazard mitigation. Operations and maintenance related hazards are handed over to the Operations Division for them to develop appropriate procedures and measures. The Construction Managers are responsible for all construction-related hazards.

The Hazard Identification and Control Process is documented as a divisional procedure [5]. POSSC and the Safety Committee periodically audit the Safety Working Groups who in turn audit the hazard controllers to ensure that the procedure is effectively implemented.

2.5 Quantitative Risk Assessment

For specific hazards with high uncertainty or with high residual risks, Quantified Risk Assessments (QRA) are conducted by assessors with in-depth knowledge of the equipment under review to assess the risks more comprehensively A typical QRA comprises fault tree and event tree analyses and risk modelling for the scenarios under assessment. Relevant MTR experience, rules and procedures are referred to in the determination of accident sequences. Event occurrence rates are as far as possible derived from MTR's own database. Data sources, key assumptions and the sensitivity of the risk ratings to changes in event probabilities are all recorded in the analysis reports

2.6 Overall System Safety Modelling

The System Safety Model (SSM) [6] was used during the course of the project to set safety targets for Contractors to meet with their systems, and to provide a best estimate of the overall risk arising from accidents occurring on the Airport Railway. The SSM took into account proposed safety mitigation features and computed an overall cumulative residual individual risk for various exposed groups who work or travel on the Airport Railway. The key stages of the modelling work are as follows:

- Developemnt of risk criteria based on the risk targets applied for the rest of the MTR system, making allowances for the differences in the type of usage and journey length between the two systems.

- Identification and evaluation of major hazards which may arise from the operation and maintenance of the railway

- Estimation of the frequency with which accident-initiating events may occur, based on the identification and evaluation of hazards, and the reliability of the various railway systems.

- Estimation of the possible outcomes of accidents which remain plausible, even after the various safeguards built into the design and operation have been taken into account.

- Evaluation of the consequences for passengers, members of staff and the public for each possible outcome from the postulated accidents.

- Comparison of the predicted level of risk to passengers, members of staff and the public, with the risk criteria which have been developed for the railway project.

The SSM of the Airport Railway predicted that the risk level for the Airport Railway passengers and employees compared favorably with the predetermined risk criteria as well as the accident rates published by the Hong Kong Government for other modes of transport.

2.7 System Safety Report

Although not required by the law in Hong Kong, the MTR Corporation has chosen to produce, in line with current best railway practice, a System Safety Report [7] for each extension project at the end of project phase to support the safety management and operation of the new extension. The Airport Railway System Safety Report contained key information on the system descriptions, overall safety management organisation, hazard identification and control, risk assessment and modelling, and overall conclusion. The purposes of this report are to provide "an initial case of system safety of the new lines" up to the handover of the new lines to the operator, and to outline the planned safety management tasks that are being undertaken downstream by the Operator.

This report has been proven to be an effective tool for maintaining an overview of the readiness of systems (in terms of safety) and for tracking specific groups of issues during the commissioning and Trial Operation phases. The process of preparing the report also strengthens the safety culture and awareness amongst MTR staff, consultants, contractors and external parties

2.8 Railway Inspectorate Consultation and Railway Inspections

Again, although not required by law, the MTR Corporation has committed to the Government that no new railway facilities will be open for public passenger service until the Chief

Inspecting Officer of Railway (usually known as the IOR of the Hong Kong Railway Inspectorate) is satisfied that the new facilities are safe for the conveying of passengers.

The Corporation has chosen to demonstrate the case for the Airport Railway operational safety in a structured manner, taking into account international best practices The key steps to establish the case for safety are summarised in Figure 3.

Firstly, the Corporation had put in place organisation 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 the arrangements and significant findings from the safety analyses were then summarised 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 produced to facilitate the discussions.

The final stage was for the Inspectorate to conduct a series of on-site Railway Inspections 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. As inspections were conducted a list of improvement actions was agreed and built up. The actions identified were divided into two categories:

- A- Actions to be completed before the facility could be brought into use
- B - Actions to be completed as soon as possible after opening (timescale agreed between IOR and MTR)

The Corporation reported progress and completion of improvement actions to IOR on a regular basis. Upon the completion of all safety work by MTR, the IOR reported his findings to the Chief Secretary of Administration of Hong Kong SAR, expressing his opinion that the railway is safe for public passenger service.

3. INTEGRATION OF SYSTEM ASSURANCE INTO PROJECT MANAGEMENT

The basic philosophy of safety management in MTR is that the safety responsibilities are with the "line management" (these are persons who have the direct control over the work). In the project phase, these are 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 (known as the Specific System Assurance requirements – SSAR) are specified in the relevant contract documents. The SSAR lists clearly the required analyses and assurance tasks that must be conducted in the contract to ensure that the safety and reliability objectives are achieved. The requirements in different contracts are commensurate with the risk involved.

The consultants/contractors are required to undertake system assurance analysis as an ongoing process throughout the design and development phase. After contract award system assurance staff and the relevant discipline engineer review all submissions received from consultants and contractors that contain operational RAMS issues By managing the fulfillment of the contracts, the managers will be able to ensure that the proper considerations have been given to the system safety aspects of their work.

To improve the timing of the necessary contract control, milestones in future Extension Projects will also be linked to the completion of some of the analyses. This will ensure that system safety will be considered at the right stage of the project and improvement can be introduced at the most cost-effective way. Periodically during the life of the contract, compliance audits of the contractors' system assurance activities are conducted to identify weak areas and improvement opportunities. The audits also provide a mechanism to support the relevant milestone payment.

4. FUTURE DEVELOPMENT

Despite the success of the Project System Assurance Process in managing the system safety of the Airport Railway, refinements and improvements have been identified for implementation in future Extension Projects. Some of the more noticeable improvements are:

- Enhancing the audit elements of the process so that a wider range of design consultants and contractors will be audited to cover both their hazard control work and safety analysis work;
- Conducting periodic in-house briefing for project team members on the rationale and approach of the process,
- Integrating the safety and RAM analyses to optimise the use of resources and to reduce costs;
- Involve operators and maintainers at early design stages to identify and resolve operational safety issues;
- Developing a more formal control framework (by the software team) for software development, and
- Key safety issues should be discussed with the Railway Inspectorate and other relevant Government departments as early as possible to agree the principles of the resolution methods.

5. CONCLUDING REMARKS

5.1 The Project System Assurance process is an effective tool for assuring system safety and demonstrating the case for safety of MTR Extension Projects.

5 2 The lessons learnt from Airport Railway shall be used to further improve the efficiency and effectiveness of the process for future MTR Extension Projects.

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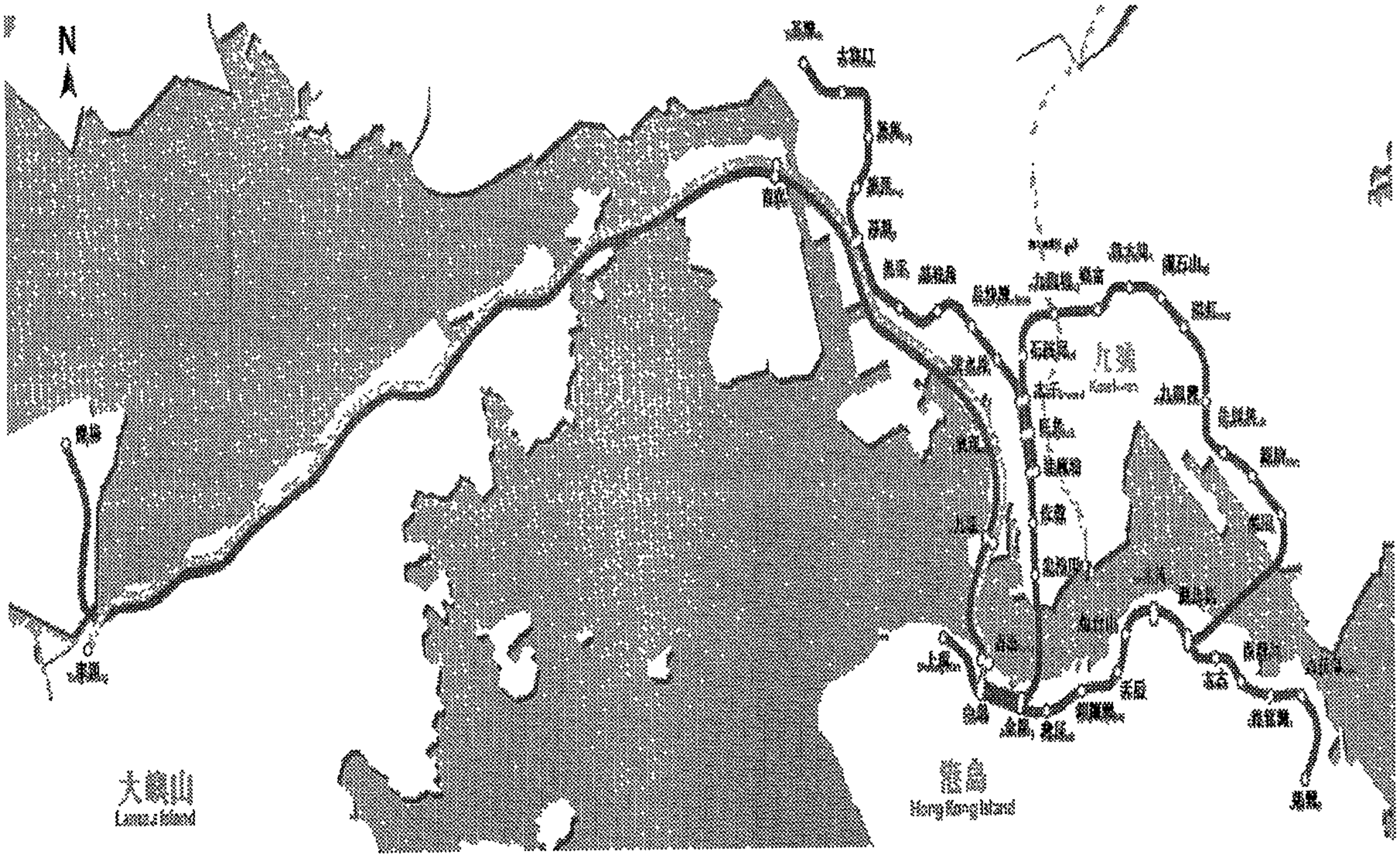

Figure 1 The MTR System Route Map

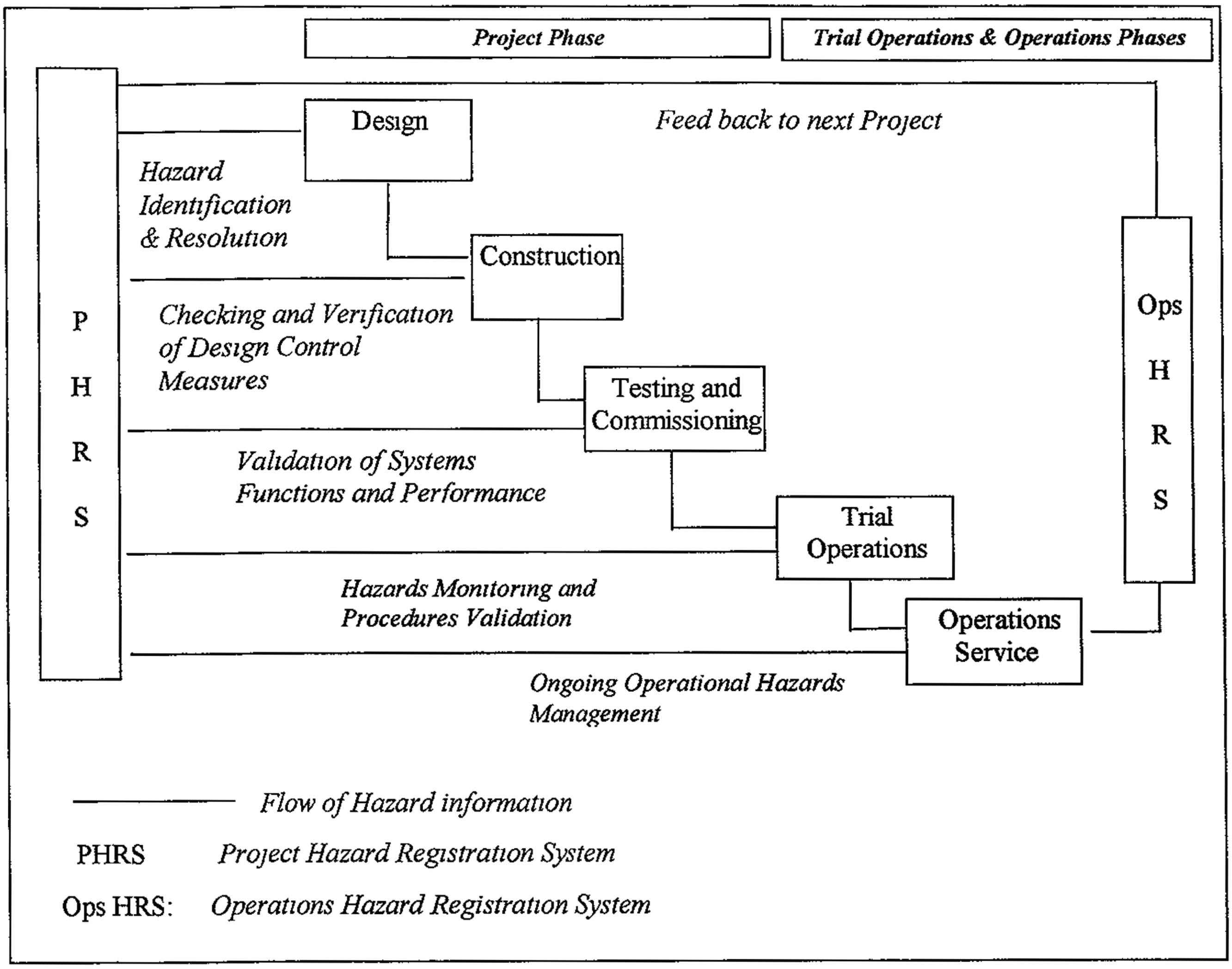

Figure 2 Hazard Information Flow for Managing System Safety

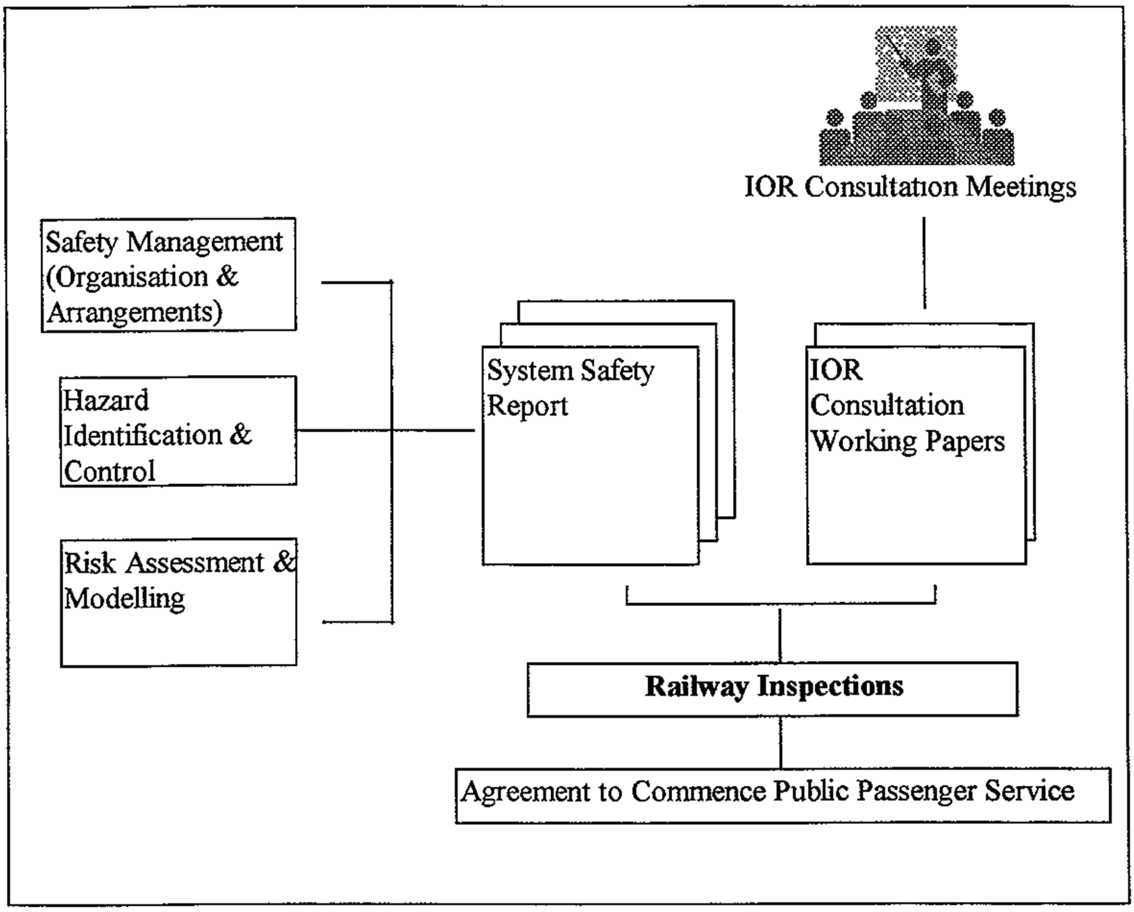

Figure 3 Demonstration of the Case for Airport Railway Operational Safety To the Railway Inspectorate

International Rail Safety Conference

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Fabrice de Jouvencel

Risk Management as applied to the carriage of Dangerous Goods on SNCF

Publisher
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[redacted]

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The Opérating System Department is in charge of the conception of the safety system of SNCF, including rules, technical installations, and human role. This department establishes the functionnal requirement specifications of the new (or modified) systems, especially those concerning control/command, writes safety rules and regulations, and defines the principles of the management of safety opérators. It is also in charge of defining the safety requirements concerning train opérators running on the infrastructure. The department manages many safety studies, especially in order to estimate the safety level of the new, or modified, systems.

Former missions assumed in SNCF :

<u>1993 -1996 : Head of Traffic Management Department of the Infrastructure Direction of SNCF :</u>

Responsible for daily global opérationnal traffic management of SNCF.

Responsible for the global regularity level of the circulations.

Responsible for the definition of the global traffic management system: organisations, tools, and opérators.

<u>1987 - 1993 : Head of Transport Division (Operating Traffic Management) in the area of LILLE :</u>

Responsible for daily regional operationnal traffic management

Responsible for regional regularity level.

Responsible for the definition of the organisation and management of infrastructure operators and train crew (drivers) establishments.

Responsible for the opening to traffic of the North-Europe LGV beetween PARIS and LILLE, and studies for EUROSTAR traffic management, especially concerning operational regulations for drivers and signalmen.

<u>1983 -1985 : Technical Assistant of the Director of Congo/Océan Railway in Pointe-Noire:</u>

Implementation of a new method of objectifs-based cooperation beetween France and Congo.

Opening to traffic of a new portion of the line between POINTE-NOIRE and BRAZZAVILLE.

<u>1982 - 1985 : Manager of Paris-Nord Station (« Gare du Nord ») :</u>

Responsible for the management of the whole station, both for commercial and technical aspects.

<u>1977 - 1982 :</u>

Various missions in the area of PARIS-NORD, including three years as safety manager in PARIS-NORD station during the period of the construction and opening to traffic of the new underground station for interconnexion between SNCF and RATP.

<u>1976</u> : engaged in SNCF (area of PARIS-NORD); various periods of training.

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(FP/D \TEXTES\BENECH\BENECH1 DOC)

Paris, 15 july 1999

RISK MANAGEMENT AS APPLIED TO THE CARRIAGE OF DANGEROUS GOODS ON SNCF

Each year railways carry tens of millions of tonnes of dangerous goods. Dangerous, or hazardous materials (hazmat) account for 15% of the French Railways' annual freight carriage. The railway mode is safe and well-suited to carriage of hazardous materials on a large scale. However, hazmat transport is often seen as posing major risks for the environment and humans. Accidents often have a major negative impact on the carrier's image, the freight customer's image and on government authorities, since media handling of such accidents tends to focus on assigning responsibility for the event When that happens, all the real or alleged shortcomings and responsibilities are widely exposed.

This paper outlines the strategy developed by the French Railways (SNCF) to improve the performance and safety of these carryings through an overall risk management approach, supplemented by specific actions conducted within various fields, with the understanding that the safe carriage of dangerous goods benefits from the general safety arrangements provided for rail transport on the whole

I - THE CHARACTERISTICS OF HAZMAT TRANSPORT IN FRANCE

a) *In terms of market share:*

In France, the rail mode in 1998 carried roughly 18 million tonnes of hazmat, representing 6 4 billion tonne-kilometres This compares with 20 million tonnes and 6.8 billion TK in 1990, and 24 million tonnes carried and 7.4 billion TK in 1982.

Railway hazmat traffic represents about 35% of hazmat carriage by all modes, with road having a 60% share and waterways handling the remaining 5%.

SNCF hazmat shipments represent about 15% of SNCF's total freight carriage, whether expressed in terms of T, TKT or overall sales.

b) *Type of hazardous materials carried by rail:*

Goods are qualified as "hazardous" or "dangerous" in accordance with the definition given in the RID (the regulations governing the international carriage of dangerous goods by rail), which was put into application in France in 1997 (such that it also applies to domestic traffic), by a Ministerial Decree transposing European Directive 96/49 on "approximation" of the laws of the member states with regard to the transport of dangerous materials by rail

The RID expressly bans certain objects and materials from being transported and specifies the conditions under which the other hazardous goods must be carried. Only those 3500 substances designated in the RID's alphabetical listing of materials are allowed to be transported Some collective headings authorise carriage of materials not designated by name in the RID

About half of all hazmat carried by rail in 1998 came under Class 3 (flammable liquids), whereas gases (Class 2) account for about 20% of overall hazmat tonnage and oxidising substances (Class 5.1, mainly fertilisers) and corrosive substances (Class 8) each account for 10% The remainder of the tonnage carried is distributed between the other classes, explosive substances and articles (Class 1) representing 0 05% and radioactive materials (Class 7) about 0.5%.

c) *How railway hazmat transport proceeds:*

Two-thirds of hazmat carryings are handled by block trains (full-trainloads of trains made up solely of wagons of the same type); the last third is handled by the wagon grouping technique which consists in sorting wagons in the railway marshalling yards to form trains going to different destinations, the wagons themselves coming from different freight stations

Twenty-one marshalling yards are used for grouping (as compared with 28 in 1990 and 40 in 1982), two of which are dedicated to combined transport

The average number of hazmat wagons marshalled by more or less automated means varies, depending on the yard, from 10 to 200 wagons per working day. It represents about 3 to 15% of all wagons sorted

In these yards there may also be a flow of trains passing through for locomotive change which of course must be taken into account in the hazmat traffic handled by these stations.

The SNCF network comprises about 30,000 km of track, most of which – except for the new high-speed lines – is accessible to freight trains that could include hazmat wagons
This network is now the property of "Réseau Ferré de France (RFF)", a new establishment created in 1997, and which assumes the funding of all the maintenance and renewal of the infrastructure components.

II - THE RISK ASSOCIATED WITH HAZMAT CARRIAGE BY RAIL: A SMALL ONE

Available statistics for France and more broadly for Europe show that the risk, i e the product of the frequency of events times their seriousness, is objectively small It is small, in fact, regardless of the transport mode. Seriousness is appreciated from the angle of the consequences for the population, for the natural environment and for operators working in the logistics chain The seriousness can be great; this is why emergency response procedures put in place or planned by the national governments or the European Union consider that a hazmat transport accident may, possibly, take on the proportions of a "major accident", given the potential risks tied to the nature of the goods carried

Each year, 250 events involve hazmat wagons On the average, less than 5 of them are deemed to be rail-related hazmat transport accidents by the Ministry of Transport and it deserves to be noted that less than 3 result in loss of confinement and therefore spills

Casualties, fortunately, are very rare There have been no deaths over the period under consideration, that is, since 1982 Two or three events each year are considered to be accidents merely on grounds of the substantial precautions taken, preventively, by the government authorities, such as evacuations or confinements of populations or temporary closings of transport infrastructures.

All the other events, in other words 95%, are incidents mainly limited in scope to small leaks resulting from poor closings of valves or equipment failures. In some cases they are non-events recorded because of errors of evaluation which reflect the difficulties of making a diagnostic and the considerable attention paid to hazmat transport.

Analysis of information from the field indicates that roughly 50% of the events are caused by failures of the rolling stock or at least its superstructure (packing, tank, container and the like), that 35% stem from unsuitable utilisation of the containers, since leaks come from improperly closed components and 15% stem from system dysfunctionings in the railway operation proper

The accuracy of the malfunctions analysis varies in reverse proportion to the hazmat traffic in the yard concerned 90% of hazmat transport events occur in the major stations and in marshalling yards in particular.

A certain number of these events actually originate upstream of these yards, in the sites from which the shipment was dispatched, where the problem failed to be picked up during the check-listing of fitness to go on line What makes the freight stations where the anomalies are detected seem to be high risk areas is more the frequency than the seriousness of the events.

They deserve to be commended on the other hand for the positive role they play in the way of supervision to promote overall safety

In light of the criteria established by the risk assessment specialists, the major hazmat transport accident revealed by accident statistics, irrespective of the transport mode in fact, can thus be placed in the "rare or extremely rare events" category

III – THE LEGAL CONTEXT: GROWING GOVERNMENT DEMANDS

a) *At the level of France:*

The trend of the French legislative context reflects the gradually growing awareness by the public and the government of the special risk associated with hazardous materials and their transport

The law of 1987 (Law 87-565 of 22/7/87) governing the organisation of civil safety and the prevention of major hazards covers the specific risk of hazmat transport through two types of emergency action plans: the emergency preparedness plan specific to hazmat transport (PSS-TMD) covering all transport modes operating in an administrative territory (the territory of a French *département*) and the specific emergency response plan (PPI) intended to deal with the hazards arising from the existence of transit areas and activities presenting hazards or serious inconveniences.

Both plans are drawn up and governed by the *Département* Prefect (all *départements* today have a PSS-TMD action plan).

Paradoxically, new requirements appeared at the beginning of the 1990s even as the objective data concerning railway hazmat transport showed that the latter was to a high standard and that the hazmat tonnage carried by rail was continually shrinking

b) *At the international level:*

In parallel with these various French requirements, the European Commission had envisaged at the beginning of the 90s, at the request of several EC nations, to include, because of the "major risk" associated with hazmat transport, certain railway facilities (marshalling yards) and maritime facilities (harbours) in the scope of application of the new, so-called "Seveso" Directive, called Seveso II, that was then under scrutiny and which concerned the control of hazards associated with major accidents involving hazardous materials

SNCF considered that the Seveso II directive was not appropriate for railways and it emphasised to the Ministries concerned the actions it had undertaken on its own to ensure safety in hazmat transport It took part in 1995 in the study that the International Union of Railways (UIC) had agreed to carry out with the European Commission (DG XI and DG VII) and the national government agencies pursuant to the "common position" adopted by the Council of Ministers of 22-23 June 1995.

Finally, marshalling yards were deleted from the directive's scope of application. In counterpart, the Council invited the Commission to make proposals for ensuring a high level of safety concerning the prevention of major hazards in harbours and railway marshalling yards

The work done in this perspective has served to highlight the fact that a railway marshalling station and its transport activities form an integral part of the transport chain It underlined the inadequacy of the term "temporary storage in transit" and the better adequacy of the expression "stops necessitated by the circumstances of the transport".

The latter expression is in fact used in the framework directive for the RID.

Lastly, it was established that the measures set down in the regulatory texts on the safety of hazmat carriage by rail are broadly equivalent to those prescribed by the Seveso II directive, excluding those requirements which are not applicable to transport.

IV – THE POLICY PROMULGATED BY SNCF

1/ APPROACH TO THE ISSUE

In response to the pressure exerted by the government, SNCF gradually built up the internal resources allowing it to answer the questions raised and to work out a co-ordinated policy in the hazmat field

Its response was mainly empirical It was based on giving answers – at least initially – on a case-by-case basis, since SNCF considered that wagons transporting hazmat benefited from the measures taken in general for all railway traffic The basic principle of prevention indeed consists in dealing with the risk at its source by, among other things, reducing the risks that could lead to collisions or derailments.

In line with the law of 1987, the first concrete actions taken were, beginning in 1990, to set up a "hazardous materials plan" (PMD) in the 27 yards designated by name

The main intent was to facilitate intervention by the emergency response agencies and detail the internal organisation of the railway sites concerned, as much from the standpoint of an external alert as from that of worker safety.

In parallel with this, the first "regional advisors on hazardous materials" were put in place in the SNCF regions These advisors, of which there are now 13, operate throughout the SNCF regions Their designation has since been changed to "hazmat transport experts" ("experts du TMD") and they may well be soon renamed "regional advisors on safety" ("conseillers régionaux à la sécurité"), under the terms and conditions of application of the Ministerial decree transposing into French law the European Directive 96/35, presently under discussion at SNCF

In 1992, noting the strategic value to SNCF of environmental issues, the railway created an internal task force on the environment, which has since been made to report to Strategic Management.

Also in 1992, a hazmat safety commission (CSMD) was set up within SNCF's central management

This commission, presently headed by the Infrastructure Director, works jointly with the other departments concerned (in particular the freight department) to define avenues of improvement for hazmat transport safety

By 1994, the CSMD's work had allowed to construct a co-ordinated safety plan based on a general analysis of the hazmat transport risk – a general analysis that was arrived at on a consultative basis and presented to the Ministries respectively of Transport, of the Interior (Public Safety) and of the Environment.

The analysis gave a detailed description of the consequences of a possible tank-wagon accident according to the hazardous substance involved The different types of accident selected by the staffs of the Ministry of the Environment hinged, depending on the nature of the goods carried, on the typical scenarios of UVCE (Unconfined Vapour Cloud Explosion), of BLEVE (Boiling Liquid Expanded Vapour Explosion), of discharge of toxic gas and of soil and/or water pollution

2/ THE 1994 ACTION PLAN

The action plan implemented comprised the following main focuses:

A – Prevention of accidents on line:

- improving the quality of maintenance of way work,
- strengthening the network of hotbox detectors,
- reviewing the conditions of tank-wagon maintenance.

B – Prevention of shunting accidents:

- implementation of new local transport plans for hazardous materials based on identification of the hazards of each particular yard;
- launching of about 40 local studies in the context of SNCF's corporate plan to assess the risks locally,

- training of personnel assigned to the sites shipping mostly hazardous materials

C – **Abatement of consequential hazards in the event of an accident:**

- training of the actors in carrying out the PMDs and understanding the emergency scenarios,
- enhancing the reliability of the information provided,
- increasing the impact strength of tanks.

3/ CONTENT OF THE ACTIONS TAKEN FROM 1994 TO 1999 TO FULFIL THE MAIN ACTION FOCUSES DEFINED - SITUATION IN 1999 AND OUTLOOK

A – Prevention of accidents on line:

a) Improving maintenance of way quality:

The maintenance standards for certain lines (UIC categories 7, 8, 9 non-passenger) run over substantially by trains carrying hazardous materials were the subject of examination in concert between the departments concerned (Freight and Fixed Plant Engineering) On the basis of a hazard indicator combining the magnitude and nature of the traffic carried, the potential seriousness of the consequences and the environmental criticality, an initial classification of 32 secondary lines was made at end-1994 A plan was then drawn up, to improve the lines within a 3-year timeframe, at a cost of FFr5 million, by applying new maintenance criteria to all the so-called "main lines", that is, those linking stations The plan in particular called for periodic track survey patrols and replacement of a certain number of sleepers

The list of line sections where these standards apply was updated in 1998, in accordance with RFF, to take into account the fluctuations in hazmat traffic

In 1998, criteria analogous to those selected for the main track sections were defined for certain service lines used frequently by hazmat wagons on the territory of major stations

Stations not selected for priority application of the hazmat-specific criteria continue to be accessible to hazmat traffic

Finally, in 1999 the decision was taken to look at the situation of private sidings These will be treated on a case-by-case basis through commercial contracts setting out the responsibilities and liabilities of the parties involved.

b) Strengthening the network of hotbox detectors:

In the context of its problem prevention policy of monitoring axles, SNCF has installed a substantial network of hotbox detectors along its trunk routes

As part of the actions taken to heighten the safety of hazmat transport it was decided in 1994 to add another 40 hotbox detectors in order to

- cut back the distance between 2 monitoring points, in the direction of laden train movements, on routes carrying the densest hazmat traffic,
- specifically protect the lines leading to major metropolitan areas on those routes;
- fill in the existing grid

These detectors are "4th generation", meaning that they are designed to also detect applied brakes

At end-1998, SNCF had in place 324 hotbox detectors, of which 76 on new lines

c) ***Reviewing the conditions of tank-wagons maintenance:***

Pursuant to the priorities laid down by SNCF's hazmat safety commission (CSMD), it was decided in 1994 to introduce a preventive maintenance operation named "special overhaul" ("révision spéciale") for tank-wagons carrying dangerous substances. This special overhaul focusing mainly on safety covers all of the following items: wheelsets, body-to-bogie links, suspension. It is applicable in specialised maintenance shops and carried out on the occasion of RID-imposed inspections (4-yearly tank inspection)

B – Prevention of shunting accidents:

a) ***Implementation of new local action plans for hazmat transport based on identifying the risks in each yard concerned - Local studies:***

SNCF has carried out 30-odd complete local studies covering the operating conditions of the individual yards, the nature of the hazardous materials handled or passing through and the sites' specific environment

Risk abatement measures were identified and implemented based on this detailed scrutiny, following completely decentralised procedures adapted to the specific problems of each yard Each study was presented to the government authorities together with the hazmat action plan (PMD) derived directly from the conclusions of the analyses The approach used was presented in 1996 on the occasion of the Capetown seminar in South Africa A reminder of the main topics covered by these studies is given in the appendix

In addition to this basic programme, there are another 30 sites (major stations other than yards and frontier stations) for which a simplified approach has been implemented in order to modernise the PMD when there was one or to create a PMD if there wasn't one

The PMDs are brought up to date after every important change affecting the yards

b) Training of the personnel assigned to the sites shipping mostly hazmat:

The railway decided in 1994 to improve the training of its personnel in charge of surveying hazmat wagons before departure

A specific training module was developed for the purpose.

Some twenty dispatching stations were mobilised into a quality approach in partnership with customers

C - Abatement of consequential hazards in the event of an accident:

a) Training the actors in the use of PMDs and understanding emergency scenarios:

Yards having a PMD periodically run emergency response drills with fire department representatives. This allows to test the people, the techniques and the organisational aspects

b) Enhancing the reliability of the information provided:

The input grids to the NAW application software used for wagon tracking and management were reviewed The procedures were simplified and the performances of the databases improved

The creation in July 1993 of a body designated as PRESENCE FRET, reporting to freight management, has contributed to the safety of hazmat transport. This body operates round-the-clock and uses the NAW system mentioned above. It attends to the handling of hazmat transport events (both incidents and accidents) at the request of the regional control centres It is responsible for advising the "emergency staffs" of the consignor, reporting to the shipper, the consignee and the wagon owner It also writes up the individual event data sheets and makes a monthly report

c) Increasing the impact strength of tanks:

The question of the possibility of improving the protection and strength of tank bottoms was reviewed at length by SNCF, some wagons having hemispheric bottoms thinner than the main shell although they carry particularly dangerous substances One case of leakage of methyl chloride from a wagon of this type occurred in 1993 in the Aulnoye yard because of a shunting impact

The conclusion of these investigations was that it is not economically possible to make such improvement to existing rolling stock (cost of modifications and loss of payload due to added structural weight)

However, SNCF raised the matter before the UIC early in 1996 so that account would be taken of higher strength design rules for new tank-wagons

Yet even for new wagons the economic implications just mentioned are heavy

Lastly, discussions are presently underway in Germany on the safety of hazmat transport under the aegis of the BMV. SNCF is associated with this work which is likely to amount to recommendations concerning wagons' aptitude to resist shocks.

4/ OTHER ACTIONS UNDERWAY

Setting up a real feedback of experience with hazmat transport

The Freight Department set up, at the start of 1999, a systematic feedback system on hazmat incidents and accidents The organisation of the system relies on the validation of the data collected, made by the regional hazmat experts, prior to forwarding the data to central operations.

Launching of a study on the relevance and feasibility of applying to hazmat transport an ISO 9000 and ISO 14000 type of standard

SNCF decided early in 1999 to launch such a study in association with the Paris School of Mining.

The idea is to establish, from the angle of quality, safety and the environment:

- the "broad equivalencies" between railway hazmat transport and the various standards,
- the non-comparable aspects,
- any shortcomings in the existing system;
- and the impossibilities, if such is the case.

From that basis, the study would outline the avenues of possible improvement as a function of the various markets concerned and the breakdown as between the Freight business and Infrastructure Management, and taking into account

- the timescales and the resources to implement;
- and the benefits-to-costs ratio.

5/ CONCLUSION

Every year, railways move millions of tonnes of dangerous goods The railway technique is safe and well-suited to carrying bulk loads. Yet all such movements are the source of environmental risk and can have a great adverse impact on the company's image.

We therefore need to continually prove our competence and the safety of our operations to government and to public opinion This is the goal of the policy which SNCF has been following for many years in order to maintain its transport operations at a high level of quality and safety.

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ANNOTATED OUTLINE OF SNCF GUIDELINE ON HAZMAT LOCAL SAFETY STUDIES FOR MARSHALLING YARDS

Volume 1

PART 1: General presentation of the study

SNCF and the transport of dangerous goods Company environmental policy Conditions for carrying out and following up on a study Restrictions concerning commercial data and the prevention of malicious acts Presentation of the site (Name, legacy, standing in the local economy, etc)

PART 2: Environment of the site

Urban and natural environment The environment is considered both a source of risk and a victim of a potential hazmat accident on the site Geographical, meteorological and geological data Site access Communication paths, establishment receiving the public, nearby public and private networks

PART 3: Description of site activities and equipment

This is a matter of describing the operations carried out with respect to hazmat wagons from the time they enter the site to the time when they leave the site It is necessary to describe the equipment used in order to bring to light in the subsequent stages of the study the level of safety and hazard prevention The detailed description of the hazmat traffic, after having served to verify the need for a risk analysis, allows to select the undesirable events that should be studied in Part 5 and to define the resources to plan in Part 7

PART 4: Overall safety organisation

Made up of three chapters, this part aims to describe the existing preventive actions and the best paths for improving safety, in particular those defined in the context of the General Hazmat Transport Study (1994) The first chapter presents railway safety in general, the second, measures specific to dangerous goods transport, emphasising that hazmat transport benefits from the measures taken for railway safety in general The third chapter deals with the general organisation for safety at the site under study

PART 5: Study of undesirable events

Based on hazmat traffic information on the site (characteristics of the goods handled, number of empty and loaded wagons, types of hazard, etc), the undesirable events to be studied are identified (fire, explosion, pollution, toxic discharge,), from a deterministic (and maximising) standpoint, to assess their potential consequences for the environment, especially in terms of their range of effect

PART 6: Evaluation of the risks and prevention measures

This part first focuses on identifying/listing and describing the causes that might bring about an undesirable event The risk assessment is based on analysis of the hazmat carriage events and "significant" events having occurred at the site in recent years The risks are distributed over the sidings and analysed according to various levels of causality Avenues for improving the prevention of damage to wagons are defined, as required

PART 7: Intervention in the event of a hazmat event

As its title indicates, this part concerns the studying of conditions of intervention in the event of a hazmat event It takes into account the conclusions of the previous parts and aims essentially to improve the alert scheme and, where appropriate, to define emergency response systems

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Hans Ring

Managing Safety Cost Models

Publisher
2000 International Rail Safety Conference

Curriculum vitae

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Director of Safety
Banverket (Swedish National Rail Administration)

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 at 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 reorganization 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.

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MANAGING SAFETY IN A CHANGING WORLD

MANAGING SAFETY COST MODELS

Hans Ring M.Sc.
Safety Director
Swedish National Rail Adminstration

Measuring the Cost of Safety

The cost of safety can be measured in many different ways. Of course you can measure cost for investing in safety devices, new better equipment, new safer vehicles and infrastructure, better education of your staff etc. The question is how far would you go and which costs are relevant enough?

Another way of approaching cost for safety is to measure what are the effects on the society. If people get killed or seriously hurt this has a negative effect on the society. Instead of making money, supporting your family and paying tax the same person need fincial help to get cured and people depending on him must get support from elsewhere.

The business economics concept and the socio-economic concept are the two mainstream approaches to measure the cost of safety.

There are different methods of calculating costs either you use the business economic model or the socio-economic model. I will not get into detail but of course all relevant costs have to be taken into consideration.

Very often we do not know the safety cost explicitly. Also, in some cases we do not have enough data to calculate the safety benefit of an investment. There might be too few accidents to get you a statistical value which you can use in your method of calculation. So, you might face a problem where you do not know the safety cost nor the benefit.

This is due to the fact that safety is a well integrated aspect in many of the subsystems within the railway as a whole. In some cases the safety cost of the investment can be identified and considered to be 100% safety cost. But, in most cases an investment should not be considered as a safety investment solely.

When measuring or calculating the cost of safety it is very often a matter of choice between two or more different solutions or situations.

This might make things a little bit easier for you to calculate the costs. You do not need to get the nominal or absolute value cost. Instead you can settle on comparitions between the options. Of course you have to find out what influences will the different options will have on safety and the cost.

I do not want to disappoint you but in most cases it is not of any value only to calculate the cost of safety. In fact safety may be a side effect only i.e. the most important benefit may be less waiting time for motorists on a level crossing which is to be replaced with a grade separated rail-road crossing.

In Sweden when we calculate the socio-economic cost for a railway project we compare the safety levels between the current situation and the situation after the completion of the railway project. Normally there is more than one option. The safety conditions vary from option to option and very often we will have to consider many more aspects than safety i.e. safety and environmental considerations sometimes stand against each other. In such cases it is important that you comply with the minimum requirements for all the important aspects. Once the minimum requirements have been complied with it will be the overall best solution that will be be choosen. Usually, safety will not be the critical aspect.

What you should do is to calculate the cost of investing in a new subsystem (i.e. an ATP system). You should then balance the cost with all the benefit it has on the railway system as a whole. Safety is of course one aspect but also effects on regularity, travel time (speed), flow of goods (volumes transported) etc. must be accounted for in your calculation method.

Hence, how to calculate the safety cost turns out to be a problem of how to estimate the total benefit (including safety) in that perticular project or subsystem.

The main criteria when yo want to increase or maximize safety is to pinpoint those projects which will give you the maximum overall benfit in relation to the total cost.

The "Butterfly Model"

In Sweden we do not have (like in some other countries) safety lavels fixed by the authorities and accepted by the society.

We asked a consultance company which are experts in maritime safety for help to find a simple method in determining the level of expendure to meet current safety levels. The problem we had then was related to safety investment and other safety actions regarding tunnel safety. The problem was that we had very little data on tunnel accidents and the effects different safety measures have had (or would have) on the outcome of a future tunnel accident.

The consultants presented to us a model based on the current situation in the railway system as a whole. What other accidents did we have? How often did they occur? The accidents and their outcome were plotted in a diagram. Then the question was which outcome of rail accidents did we live with today and at what frequency? Also we had to make a statement regarding safety in tunnels compared to the current safety level in the railway system as a whole. We decided that traveling in tunnels should be as safe as rail travel in general. This axiom aimed at maintaing the current risk level in the railway system while minimizing the costs.

Different accident situations were identified. We then formed a "butterfly" model consiting of a fault tree analysis combined with an event tree analysis. By this we could act preventive as well as minimizing the outcome of an accident. This gave us a number of variables which could be modeled from situation to situation. By modeling the most commonly high risk situations and the cost for actions needed to reduce the risk level to that stated in the axiom we eventually ended up with a standard set of risk reducing actions beeing the most cost effective. For the more complex tunnel projects we also identified a number of complementary safety actions if the remaining risk level after using the standard set of safety measures still would be too high.

In each new tunnel project the actual risk level will have to be calculated and measured against the acceptable risk level stated in the axiom.

The Example of a New CTC System and the ATP System

Mr. Bäckman at The Royal Institute of Technology in Stockholm, Sweden has recently made a study on the effects on investing in a new CTC system based on radio communication. His study showed that the new CTC system increased safety but unfortunately it was not statistically proven by how much. In fact the new system was mainly justified by other effects like less cost for train dispatching and a more efficient traffic control. Apparently this new CTC system could not be justified solely by its safety increasing benefits.

After a series of severe rail accidents in the late seventies we in Sweden developed a new automatic train control system which supervised the driver preventing trains from passing signals at danger, supervising and if necessary controling the actual speed limit. The system was a success. Within a few years time accident rates fell and we had no passengers killed or seriously hurt for several years. The system now covers most of the train milage and 75% of the network. Since then we have had a lot of discussions going on if we should not also fit the maintenance vehicles with this ATP system. It proved that the cost were much higher due to a great number of different vehicles which all had to have individual fixed installations adjusted separately for almost every single vehicle. A cost/benefit analysis also showed that most of the accidents these vehicles were involved in had not been prevented by the ATP-system. Therefore only some of the maintenance vehicles used for hauling maintenance trains were equiped with ATP. From what we can see the costs are now dropping due to smaller ATP antennas cheaper and easer to install. This and other cost reducing aspects may make it worth to reconsider the previous made decision.

Socio-Economic Cost/Benefit Model

In Sweden we make use of socio-economic models for calculating investment levels in the rail network. The investment level is determined by the benefit the investment will give to the society.

This means that many investments are carried out by the Swedish National Rail Adminstration and do not burden the train operating companies. The track fees are set by the principle of marginal costs and thus only reflect the operational excess cost generated by the train operating companies. The track fees do not include interest charges for the investments beeing made in the infrastructure.

The calculation models and methods to be used is presented in a calculation manual covering all railway aspects like travelling time, accident cost, value of a human life, business economics and standard values for the use of different train sets etc.

When we calulate the socio-economic benefit for an investment we make use of the same value for a human life irrespective if it is an investment in road or rail safety. This means that we are equally willing to invest money to save a human life in a road or rail accident. You could argue that this is good or that this does not reflect the real world. In fact the situations are not considered equally by a motorist or by the passenger onboard a train. The motorist thinks he has more of control over the situation beeing able to adjust his speed, maneuvering out of a dangerous situation whilst the passenger on the train feels that his life is in the hands of the railway company and that he is not beeing able to monitor nor take control of a dangerous situation.

Can Current Levels of Safety be Accredited to Expendure Made?

Is it worth the money already spent? Well, this is a question hard to answer. The fact is that we do not have the total picture clear. As I said earlier safety is a well integrated aspect in the railway system as a whole. Therefore it can be hard to find out what is really a safety cost and what is not. I will give you a few examples. The cost for constructing a bridge includes not only the cost for the structure itself but also the extra cost for the safety factor used. This safety factor is often choosed with a very high ambition. Think of it, would you accept that a bridge would collapse at the same rate as we accept other train accidents? Or, would you accept that the structure of a station building sometimes gave up and it collapsed? Probably not, not even if it showed that it cost a lot to construct bridges and buildings the way we do it today.

Nevertheless, we are most interested in developing further the models for calculating safety costs and I think that even if it for political reasons would be hard to accept a higher risk in an area which proved to be so to say over-safe compared with other risks and the money spent, it is very important that we get more knowledge so to get a more clear picture of safety investments.

Expendure Needed to Meet Future Requirements

The Swedish Parliament have decided on a vision zero applicable to rail accidents. This new approach applies as a principle to all transport modes.

This is part of the Government transport policy for the next 10 years. The previous transport policy meant that we got a separation between infrastructure managing and train operation. We have also created a partly deregulated rail market with competition between rail freight companies running on the same tracks. Now, we see more and more of private competition in passenger rail transportation as well.

This indicates that political policies and a firm political determination is vital for the rail transport market. Political objectives must be based on what is accepted by the industry and what can be obtained with reasonable efforts. It is necessary that the fundamental conditions are set by the politicians. Only from this platform the market actors can make success and by customer orientation form a durable rail transport market.

We have not yet developed a model for calculating future levels of safety investments due to the new vision zero. I would like to point out the difference between a vision and an objective. The objective beeing more definite whilst a vision is more of a state of mind.

For the future as well as for today the level of expendure must balance the benefit of the expendure. I see no point in finding a current level of expendure lasting also for future requirements. I will discuss this matter later in my presentation. However, in some cases regarding very expensive projects it might make sense to invest in subsystems capable of tackling future demands like increased axle load or higher speed. This is limited to parts of the railway structure like bridges or subsystems where the marginal cost for afterwards increasing the capability would be excessively high compared to the marginal cost for a limited excess capabilty built-in in the subsystem.

For a long period we have in Sweden developed a programme for reducing rail-road accidents. The programme has ever since it started more than 10 years ago been based on statistical facts and the outcome of rail-road accidents as well as on cost for different measures. The programme has been revised several times and the current objectives (for the period 1997 – 2007) are

- Crossings on lines with a traffic flow product over 800 should be fitted with barriers before end of 2007. The traffic flow product is beeing calculated as the average number of cars per day multiplied with the average number of trains per day multiplied with the maximum permitted train speed in k.p.h.
- By the year 2007 all the remaining open crossings on double track lines should have been closed or equipped with barriers.

- The number of open crossings shall be cut by 50 % compared with the number of open crossings existing in 1997 (1.900 crossings).
- There has to be made a separate cost benefit analysis for every crossing on lines with train speeds exceeding 190 k.p.h.

There are three levels of priorities in which order to take action when carrying out this programme.

In our plan for the period 1997-2007 we have made reservations for 900 billion SEK regarding level crossing safety.

We have been quite successful so far in our risk reducing activities concerning level crossings. Since we started back in 1988 the number of accidents have been reduced by 66%. Ten years ago we had more than 100 accidents per annum. Last year we had less than 30. Also, the number of people killed in rail-road accidents have decreased from 30 per annum to less than 10.

When do You Stop at Assessing Your Risks?

If you have a safety level that must be achieved than it is simple, provided that the cost is reasonable.

In other cases I would say that you never can stop assessing risks. Of course there is a limit to assessing risks in each and every project or at a particular situation, but almost every situation is unique and therefore you have to come to an agreement with the shareholders of that perticular project. The conditions connected to different projects also differs from time to time.

Why is it like this? Well, the demand for safety seems to increase over time. We want to pay more to have a safe journey or live in a safe environment i.e. cars of today have much more built-in safety devices than earlier and car manufacturers now think in terms of safety technology. In fact safety in now being built-in in the structure of a car already from the beginning.

This means that once a long-time set up goal has been achieved you have to think of the next step to and make new calculations. Quite often the top subject changes due to what accidents occurs in the society. I wish it was not this way but as you all know any major accident will have influence on the future actions. The feelings of the public will quite often challenge hard facts and figures. We can see that there are also influences between different transportation modes i.e. regarding tunnel safety (influences between road and rail) as well as international influences from accidents abroad. The world of today is getting more and more international and subject to quick changes.

However there are some guidelines I can give you. The objective in each and every situation should be

- Keep it simple
- Use common sense
- Always broaden your view when calulating the safety cost – measure all the effects (not only those who will influence safety)
- After all (like in all decision making) you have to consider more than just the calculations based on facts.

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MANAGING SAFETY IN A CHANGING WORLD

MANAGING SAFETY COST MODELS

Hans Ring M.Sc.
Safety Director
Swedish National Rail Adminstration

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Measuring the Cost of Safety

The business economics concept and the socio-economic concept are the two mainstream approaches to measure the cost of safety

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Measuring the Cost of Safety

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- Balance the cost with all the benefit it has on the railway system as a whole.
- Also effects on regularity, travel time (speed), flow of goods (volumes transported) etc. must be accounted for in your calculation method.

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Measuring the Cost of Safety

The main criteria is to pinpoint those projects which will give you the maximum overall benfit in relation to the total cost

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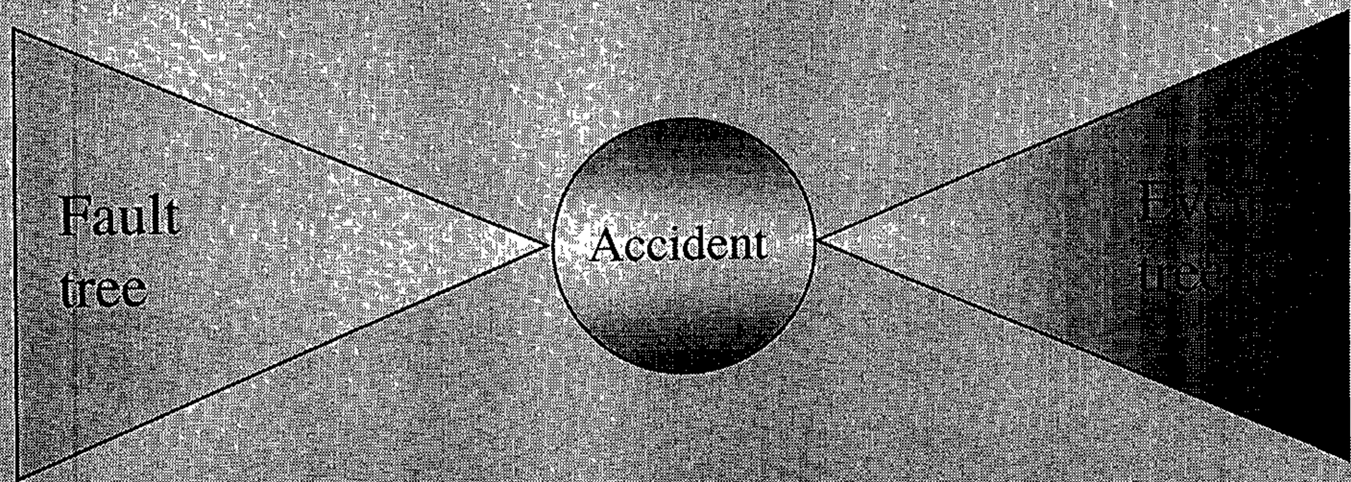
The "Butterfly" Model



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Socio-Economic Cost/Benefit Model

- In Sweden the investment level is determined by the benefit the investment will give to the society.

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Socio-Economic Cost/Benefit Model

- The track fees are set by the principle of marginal costs.
- The track fees do not include interest charges for the investments beeing made in the infrastructure.

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Expendure Needed to Meet Future Requirements

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When do You Stop at Assessing Your Risks?

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George Smallwood

Managing Safety in Mergers and Divestitures

Publisher
2000 International Rail Safety Conference

George A. Smallwood
Assistant Vice President – Manpower, Training and Operating Practices
Burlington Northern Santa Fe Railway Company

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 of Road Foreman of Engines at Gallup, New Mexico. His assignments later included General Roadforeman of Engines/Supervisor 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 endeavors was a commission in the United States Army Reserve as a transportation officer.

George attended the University of Tennessee at Chattanooga and currently resides in Flower Mound, Texas with his wife, Rebekah.

MANAGING SAFETY IN MERGERS AND DIVESTITURES

Presented To

1999 International Rail Safety Conference

October 19 - 22, 1999

Banff National Park, Alberta, Canada

LIKE THE NATION it serves, the Burlington Northern Santa Fe Railway Company is a melting pot of people, places, practices and policies. In its 150 years of service, BNSF has acquired, incorporated and merged its way from 335 predecessor lines into one of the world's largest rail systems with 34,000 route miles in 28 U.S. states and two Canadian provinces. 44,000 members strong, BNSF is proud of its heritage and seeks to keep its constituents interested in their past while looking forward to the future.

As a corporate officer for the former Santa Fe Railway Company, I was given the opportunity to participate in the merger process with the Burlington Northern Railroad. In that capacity I was fortunate to see the dos and don'ts of "merging." Assigned to Labor Relations I assisted in negotiating merger implementing agreements and the creation of our system safety and discipline policies. The overall combination process was a safety success. Today's railroad is significantly safer than its predecessors. The improving safety trends of the former were successfully bridged to the latter. Since that time I have followed the safety concerns of other merger processes. Following are my thoughts on how to get there from here.

"Safety is the most important element. . ." our first operating rule tells us. In modern railroading this applies not only to train operations but to the financial bottom line as well. "An unsafe railroad is an expensive railroad." This maxim becomes truer every day in the U.S. Legislation, regulation, litigation, productivity and morality all work to eliminate unsafe practices, policies and procedures. Historically, the railroad industry has been goaded into change. The predominate thinking was that change was not in the financial interest of the company. Today, with the flick of the pen, regulators can change the playing field. Labor agreements alter the corporate course; lawsuits motivate. This confusing mixture of change, mergers and divestitures presents an excellent opportunity to improve the safety culture and process of rail operations, albeit an opportunity often missed in practice.

Economics (called by many names) is the primary driver in mergers and divestitures. Because of its impact on shareholders, employees and affiliates, money matters are given primary, often absolute consideration. Other concerns, such as safety, may suffer. We can count on the normal platitudes and required "plans" but the final effect is often "chase the buck" (insert slang for your currency here). This failure to elevate safety to its rightful position in the merger schematic will result in an "emperor's new clothing" methodology wherein all the right words are said but safety and performance suffer, oftentimes dramatically.

The last two decades have seen a substantial increase in large-scale railroad mergers and acquisitions in the U.S. The 90's have turned to international affiliations, etc. The news is full of accounts of "railroad merger meltdowns" in performance and safety. . .performance and safety. Strange how the two seem to go hand-in-hand.

AGGREEMENTS, POLICIES AND THE LAW

There exists in U.S. railroad lore the idea that safety is non-negotiable. Safety must remain a policy rather than an agreement; management prerogative not labor's instrument. In practice, it is impossible to separate safety for other issues. Virtually all items have a safety component. The result is an industry with numerous labor agreements that do have an effect upon safety. These agreements vary wildly from property to property even between locations on the same railroad. This is often the result of previous mergers, acquisitions and other affiliations.

Existing safety policies across the U.S. are equally varied in design. These policies tend to reflect internal railroad culture and necessary regulatory compliance. Individual U.S. states, through their indigenous public utilities establishments also influence policy. Many railroads have separate policies that apply to specific portions of the operations and not others.

American railroads often show poor judgment by writing or rewriting operating and safety rules after an accident or injury regardless of cause. This may occur even when the pre-existing rule was sufficient. Perhaps this gives the illusion of "doing something."

Being an ancient industry (by American standards) railroads have been subject to a great amount of legislation, so much, in fact, that substantial deregulation was needed in the past several decades to keep the industry viable. Having reaped the successes of that deregulation there exists today a strong movement desiring the return of the industry to a higher degree of regulation. It is said jokingly (I think) among some that this business just cannot stand prosperity. This large volume of law and regulation shapes railroad safety rules and practices. Problems in mergers and acquisitions prompted much of this legislation.

Let us look at a few hypothetical merger related problems:

By agreement, railroad number 1 allows its operating employees to wear any type of shoe they please as long as the shoe meets a few broad requirements. Anything beyond a tennis shoe will work. Railroad number 2 requires a boot that supports ankles (effectively eliminating "cowboy" boots). Railroad number 3 allows its employees to pick from a narrow list of specific boot types and brands only. Railroad number 4, like number 3, is very picky but has agreed to pay for one-half the cost of the boots, once a year. Railroad number 5, like 3 and 4, is selective but picks up the entire tab for the boots twice a year. All five railroads merge. What shoe is acceptable on the merged railroad? The new management team wants option previously held by railroad number 2. Labor wants option from railroad number 5. The result: everybody does what they did before unless, by transfer, they work in territory of another of the former railroads in which case the employee feels he can now be governed by the perceived less rigid standard but in fact is required by local management to continue to conform to his original railroad's more restrictive policy creating a "two-tiered" system wherein employees have different shoe requirements in the same location. That employee gets tired of the run around and goes back to his original railroad (now a division of the merged railroad). Local management at home tells him he again qualifies for "home" treatment. The employee, because of his transfer, desires to adhere to the less restrictive rules of the division he just left, after all, was not that the approach of management at the last location? He appeals to Labor Relations. Labor representatives, clinging to past affiliations, refuse to negotiate a new "shoe requirement" and years later the question of what kind of shoe the employee must wear, who pays what, when, ends up in front of a labor mediator who is as confused as you are.

Railroads 1 and 2 both require the wearing of eye protection by policy. Railroad number 2 has an agreement permitting the use of glasses without side shields. Railroad number 1 requires the side shields. After merger what happens? All employees carry snap on, snap off side shields and apply or remove depending on where they are working, etc. Have we served to enhance safety?

Regulations in one state provide for criminal penalties for accidents where crewmembers allow a train to traverse a specific location while not conforming to the railroad's own train makeup rules. Railroad number 1 operates through this state. After merging with railroad number 2 that does not operate in that state what training requirements must be met in order to allow employees from railroad 2 to work on railroad 1? Is pay for training provided for under which railroad's agreements if rates are different (they always are)?

Under a mediation board ruling locomotives on railroad number 1 require a desk for the conductor. Under a similar board ruling, locomotives on railroad number 2 may substitute a metal clipboard for a desk. Railroad number 1 does not have to equip their locomotives with air conditioning. Railroad number 2, by agreement, does. Number 1 chose to order its fleet without extended range dynamic brake. Number 2 have extended range. Which locomotive must be used on any given train in the month of May?

It is easy to see how business combinations can become feudal states with many little fiefdoms, each replete with their ways of doing things. In some U.S. mergers, this patchwork layout has been allowed to remain. The idea is a "separate but equal" philosophy, which appears on the surface to be workable but ignores the very root of many safety concerns: morale.

MORALE

As an operating Superintendent, I learned many valuable lessons. Safety is not an end unto itself. So often in our industry we compartmentalize issues as though they had nothing to do with anything else. When meeting with one of my local chairman for the first time I was confronted with a gentleman wearing a custom made hat. The hat was a typical American baseball cap with four bills each pointing in a different direction (envision a cap with a bill pointing to each major point of the compass). One bill had imprinted the word "PERFORMANCE." Another had the word "DISCIPLINE." "UNION" adorned the third and "SAFETY" the last. As we spoke he would stop me and turn the cap with a particular bill pointing forward. "OK, now we can talk about a discipline case; wait, let me put performance up front," then we talked about problems with on-time departure of trains. Near the end he whipped the "SAFETY" side to the front. With each bill forward he would change his demeanor. (You can imagine what the "DISCIPLINE" bill/face looked like.) What was interesting was his "who cares" look when he had the "SAFETY" bill forward. He believed that railroad management thought of safety as Americans think of automobile hood ornaments; pretty but not of much use and certainly not integrated into the other aspects of business. My challenge was immediately apparent. I had to make a universal paradigm change elevating the importance of safety on my

Division. Safety must pervade every aspect of the operation. While that is another story for another time, the ultimate result was a railroad division of over 1500 employees that went over one year without a single Federal Railroad Administration reportable injury.

Safety must become a mindset. That mindset must pervade the entire operation. It must permeate all decisions. When dealing with mergers and divestitures the same system must rule. To do any less is to sacrifice morale.

It is oftentimes difficult (especially for finance, accounting and labor relations) to understand the correlation between safety and morale, after all, we pay them appropriately. Why should they be unhappy? Granted, money is an important part of the equation but there must also exist a personal interest. That interest is called "safety." You, the employer, really do care about my well being, not just my financial health. If employees are satisfied in this matter before a business consolidation, why would they not remain satisfied after the combination as long as no "benefits" are taken away?

I believe that answer is somewhat along the lines of the old proverb "the grass is always greener on the other side of the fence." What previously sufficed may now appear inadequate based on "benefits" observed on a new affiliates territory. This may occur despite the fact that the other affiliates think exactly the same thing about your organization on a different point. This leads to the Labor Relations officer's worst nightmare: "cherry picking" the best aspect of different agreements and attempting to negotiate a new and better one containing those enhanced provisions. Fear of this process is so strong that supervisors may attempt to artificially separate merged entities by keeping seniority and operating practices separate. Now we've reached the "cut off your nose to spite your face" phase. When employees see the length to which a business will go to prevent elements that would, in the employee's minds, enhance safety, they become convinced that their safety is subordinate to cost; not the ideal environment to promote safety.

If we have successfully compartmentalized safety into something completely separate from operations, we are now content to move forward with our merger implementation plan. The problem now facing us is why we cannot seem to get the operation back to pre-merger levels in safety and performance. The next steps will invariably be to blame any one of a host of possible scapegoats for our problems. Computers, locomotives, fleet size, competitors, weather. . .all can be blamed. Why is everyone surprised that personal injuries and train accidents also increase in sync with performance degradation?

Here is a personal maxim that I believe most would agree with: Safety is directly proportional to morale. If you have high morale, you will have good safety practices. The rub comes as we play with the word "morale."

To digress, my greatest lifetime disappointment is my inability to write a book on "quality" (and earn a fortune). As a young corporate officer, I was trained as a quality facilitator. Later, as my employer changed quality guru's, I was retrained to the new mantras, so on and so forth. I have read all the great quality books and am intensely jealous of the hundreds of millions of dollars earned by the quality experts that authored these books. In my attempts to publish I run into writer's block after the first sentence. I cannot seem to get past the quote of a very dear friend who said, "do unto others as you would have them do unto you." There just does not seem to be anything left to say after that.

Morale, to my mind, is simply the fulfillment of the golden rule. Mergers and divestitures present change. Change can be positive; morale can be maintained, even improved.

THE PERFECT MERGER

The combining groups and the legal, financial and moral environment in which they occur determine the technical aspects of mergers. There are many that do an excellent job of making the necessary adjustments to make a good merger from this standpoint. I am continually amazed at how resourceful many railroad officers can be in this arena. The problem from the safety perspective occurs when safety is relegated to an inferior, separate role. My experience with the Burlington Northern and Sante Fe merger was very positive. Because of significant safety problems immediately before and after the combination, the merger team was acutely aware of the need to inculcate safety as the paramount directive. Mistakes were made, but overall, the process was smooth and safety improvement continued throughout. From that experience I would like to offer a few general thoughts:

1. Meticulously lay out the safety practices and issues of all <u>individual</u> components of the merger. Categories might include personal protective equipment, operating and safety practices, training, labor practices and agreements, incentive and disincentive (discipline) processes, safety devices, tools and compensation associated with any of the above. The grass roots elements of labor and management must be involved. Nothing is more damaging than royal edicts from the 33rd floor about safety practices that people in the real world know are foolish. Sounds absurd but many on the labor side of the formula believe this process to be the rule, not the exception.
2. Evaluate the effectiveness of each element identified in step one. A good unbiased soul-searching look at past practices with input from all sources may eliminate or change items that are then in place due to neglect, redundancy, tradition, past practice and old Spanish custom. Ideally, accomplishing this process before the business combination will help reduce the "one-upmanship" process that occurs between groups after merger. Caution, in the U.S., altering processes and making changes before the fact for a merger or proposed merger may be illegal. Having said that, steps one and two are, in my opinion, good business practice irrespective of plans to merge.
3. Catalog legal requirements. Some nations have provisions allowing extraordinary change during mergers. Many companies save this legal "ace-in-the-hole" to use with big-ticket items such as seniority consolidations and compensation, missing the opportunity to attach smaller riders such as personal protective equipment to these changes. Determine what regulatory barriers exist. List labor agreements and practices that must change to maximize merger potential.

4. At the legally appropriate time, determine safety practices, processes and goals for the merged company. These goals should be the culmination of steps one, two and three providing for as little dramatic change as possible post-merger. It is hoped that dramatic change occurred pre-merger and has already been accepted and incorporated into the culture of the pre-merged entities. Again, legal considerations may prevent full realization of this step until post-merger. An added caution for corporate takeovers and purchases: I have seen several serious safety and operational meltdowns occur when the predominate entity simply imposes its "superior" system on its acquisition without the benefit of steps one, two and three.
5. Create a detailed plan in which the previous steps are methodically placed with appropriate actions necessary to obtain goals.
6. Communicate the plan to every member of every group that will affect change to insure that the entire plan is implemented.
7. Establish an oversight safety team tasked with insuring the implementation of safety items and practices within all merger processes. This team should consist of members from the every level of the corporation.

DIVESTITURES

Most nations have laws that govern business mergers and divestitures. The thrust of those laws is designed to benefit that nation. Safety is in everyone's interest. Divestitures usually represent a financial decision of a different sort. The gaining party is often of a lesser financial position than the previous owner or, is some cases; the previous owner is in financial peril. This may cause certain safety practices, such as the safety boot purchase plan mentioned earlier, to be abandoned. This tendency makes divestitures unpopular with labor and working groups. In the U.S., law prescribes how and under what condition divestitures may be made. These divestitures often result in the creation of what is termed a "short line."

I am not prepared to offer a study on safety of American short lines. I believe you will find that despite reduced wages and benefits, most American short lines are very well operated and display good safety records. My explanation for that success would center around the individualized approach to employees, the family atmosphere of many of these businesses and the overall satisfaction of employees being treated fairly by employers (morale?).

Being forthright and honest about planned divestitures allows effected employees to prepare for change. Holding your cards close to your chest will offend everyone including those who remain with the divesting company.

SUMMARY

Mergers and divestitures can be accomplished without sacrificing safety. In fact, several recent mergers have shown that the new corporation can actually arise safer than any of its components. Safety failures in mergers are the result of planning around safety and a cavalier corporate attitude concerning morale. The primary safeguard against this type of failure is the initial embrace of safety as the cardinal tenet of operations for the new railroad and complete safety consciousness in implementation of merger change.

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Safety Standards for training of Train Drivers in Metrorail

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Motivation for category: The paper deals with Safety standards for training of Train Drivers.

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Paper: Safety Standards for training of Train Drivers in Metrorail.

Synopsis: Divisionalisation of Metrorail as a business unit with Transnet necessitated the establishment of unique safety norms and standards for the training of Train Drivers in Metrorail. This paper deals with procedures and safety standards used in the training of Train Drivers for Metrorail.

SAFETY STANDARDS IN REGARD OF TRAINING OF TRAIN DRIVERS FOR METRORAIL.

Background:

Until 1990 the commuting passenger services formed an integral part of the Spoornet rail transport division of Transnet. The South African Rail Commuter Corporation (SARCC) was then established with the responsibility to ensure that commuter transport which has a totally different business focus, is managed on business principles. The thrust behind this was mainly for business reasons with the underlying tone of political change in the country. South African Railway Commuter Corporation (SARCC) obtains the necessary funds from the Government to subsidise the commuter rail transport.

Since 1994 the drive to establish an independent commuter rail business was launched. The ultimate aim is to privatise this mode of the business. After a tedious and lengthy negotiation process an agreement was reached with the stakeholders e.g. Politicians and Labour to establish an independent business unit within Transnet. On 1 January 1996 Metrorail was established as an independent business unit and Rail Operator within Transnet. Transnet is the legal entity for Metrorail and the SARCC the other legal entity and also the owner of the assets. This brought about that a Metrorail Head Office was formed mainly staffed by SARCC staff to ensure that the necessary policies and guidelines were in place needed for the safe operating of a commuter business with a business focus.

Metrorail Mission statement :

"We render a safe, effective, efficient and affordable rail commuter service and operate the public metropolitan rail system in partnership with all stakeholders, with a total journey focus, based on commuter needs."

The importance of safety to ensure the continuous existence of the Company is a core of the Operations and receives a high priority for decision making.

However, Metrorail does not operate solely over the SARCC owned lines but shares a great part thereof with Spoornet and visa versa. Metrorail is the Operator of the commuter service in four major regions viz. Johannesburg, Cape Town, Pretoria and Durban. In the other two regions Port Elizabeth and East London where there is a commuter service, it is a buy-in service.

Safety Standards and Principles

Taking cognisance of the abovementioned Metrorail entered into an agreement with Spoornet regarding the operational and safety requirements. In order to ensure that the two parties could harmoniously co-exist and interface, a set of principles for safe movement on rail (as below) was drawn up:

PRINCIPLES FOR SAFE MOVEMENT ON RAIL (SMOR)

PRINCIPLES APPLICABLE TO TRAIN AND SHUNTING MOVEMENTS

Before moving
- the track must be defined
- the defined track must be clear
- issue / obtain authority

Whilst moving
- adhere to speed instructions
- adhere to trackside and other indicators

Stop
- at limit of movement
- when and where scheduled

Whilst stationary
- stand clear (not foul)
- be secured (against movement)
- be protected

AUTHORITY
- shall be issued and accepted only by licensed persons
- shall have one meaning only
- shall not allow conflicting (following or opposing) movements
- holds good until executed or surrendered / withdrawn

COMMON TO MOVEMENT

- rolling stock must be serviceworthy
- infrastructure must be trainworthy
- authority to be issued, accepted and handshaken
- know location, extent and limitation
- consider feasibility of execution
- have continual communication

COMMON TO PERSONAL BEHAVIOUR

- be alert, vigilant and assess surroundings
- responsibility cannot be shared
- be fit for duty

COMMON TO ABNORMAL CONDITIONS

- have a hierarchy of fall-back procedures

These principles forms the core of the safety standards and procedures and are not time or technology bound.

Train Drivers:

The business need for Train Drivers created a new challenge as the appointment of commuter Train Drivers was historically done from the most experienced Train Drivers. This luxury was no longer available and Metrorail was at the same time pressurised to eliminate job reservation. This job was a typical example of job reservation during the "äpartheid" days. An agreement was reached with Labour by Spoornet that the minimum level of entry to this grade is four years "footplate" experience. This meant only posts closely related to that of Train Driver were eligible for appointment in this position. Inherently the requirement of this kind of experience relates to safety standards. Reducing any of these requires a sound understanding of the inherent elements entrenched in this long practised method of succession to the footplate.

Introduction:

Due to the fact that Train Drivers are the final arbitrators of safety regarding the safe running of trains, the minimum of four (4) years of footplate experience was required as entry to this grade. Footplate experience was considered as 'on-the-job-experience' which could only be obtained by Drivers Assistants' experience.

This requirement could no longer be met due to the transformation of Transnet whereby it became imperative to admit black Train Drivers to this grade. Negotiations with Labour resulted in the requirement of four years footplate experience to be reduced to two (2) years. This resulted in a gap being created as far as the 'on-the-job-experience' was concerned As stated above, safety is not negotiable especially in the Train Driver's grade.

The admittance of personnel with a different job and experiential background created a gap with an element of safety being inherent thereof.

The methods of training in Metrorail are somewhat different from Spoornet in so far as practical training is concerned due to the unavailability of a driving simulator for Metrorail. Practical training is done on a selected open line where specific practical operational scenarios are simulated for training purposes.

Safety standards for training of Train Drivers are in harmony with Spoornet and visa versa due to the fact that both parties follow the same process of accreditation of training material. The standards set for accreditation is uniform for Operators on the rail lines of Spoornet or the Rail Commuter Corporation.

Training of Metro Train Drivers is done on a decentralised manner by the four Metrorail regions. Functional training is the ultimate responsibility of the particular manager (Train Operations) of the region.

The Head Office of Metrorail will however perform the role of external examiner and finally certify the successful Train Drivers **"in training"** as Train Drivers. The Head office also monitors the training process ensuring high standards and alignment with other operators. All course material is centrally distributed from Head Office, who are responsible for the maintenance of the training material and the issuing new or amended instructions and rules to the regions.

Training Programme:

Modular training is used for the training of Metro Train Drivers. Furthermore there is a differentiated training programme to provide for the filling of gap of different levels of on-the-job-experience. Firstly Train Assistants with footplate experience are catered for and a more extensive course which includes an induction and bridging course was compiled for Metro Guards with no "footplate" experience but with some knowledge and exposure of the operational environment. The more intensive course was compiled to provide for a person with no experience on the footplate or no operational experience.

The Modular Training Programme consists of the following modules for train Assistants.

Train Working Rules (Six Modules)

The duration of these six modules are approximately forty (40) working days. On completion of this classroom training an examination will be written.

Motor Coach 5M2A (Five Modules)

This theoretical part of the training covers the knowledge of the motive power used by Metrorail applicable to Train Drivers. The duration of the training is thirty (30) working days. An examination is written on this part of the work.

Vacuum Brake System (Two (2) Modules)

This part covers the theoretical part of the brake systems for Metro Trains. The duration of this training is ten (10) working days after which an examination is taken.

On all of the abovementioned training modules the pass rate is an 80% average. However, a student will be afforded one more opportunity to rewrite a paper should he fail.

Training of Metro Guards as Train drivers

Induction Course:
Students are exposed to an induction course of twenty (20) working days. This covers general issues regarding the work environment of Train Drivers. Only test on First Aid and Fire Fighting are undertaken.

Orientation Course (Two Modules)

The duration of the course is twenty (20) working days and covers specific aspects of Train Drivers duties. An examination is written on the course.

Footplate (Twelve Weeks)

After successful completion of the aforementioned course practical training is commenced on the footplate under the supervision of the Section Manager. On completion of this course, theoretical training of the Train Working Rules is commenced. On successful completion of the aforesaid course the student will proceed to another six (6) weeks of "footplate" experience. Further training is similar to that of a Train Assistant as explained earlier in this document.

The same training programme is applicable to other applicants with a different work background than Train Assistants or Metro Guards. This has however not been put to practise in Metrorail.

Historically the only feeder to the grade of Metro Train Driver was from the Train Drivers/Train Assistants in Spoornet. This created a working environment and safety standards that are in harmony within the industry in South Africa. When the decision was taken by Metrorail to create a career path for other grades in the company, this stable environment was disturbed. As can be seen from the abovementioned training programme of Metro Guards and other applicants, cognisance was taken of these facts and the necessary precautions were taken to fill the gap and create stability and high safety standards in this critical grade.

Practical Training

This is the area of training which posed the greatest challenge for the management of Metrorail to accomplish "footplate" experience without the luxury of a simulator. Practical operational experience is provided on a selected line. Train Handling is included in this course and there are no specific time constraints on this training.

A second phase of practical training in operational circumstances is introduced after completion of supervised selected line training. This creates an opportunity to augment the competencies acquired by the student on the selected line. This phase has a time limit of eight (8) weeks whereafter the student will be evaluated and if successful, certified as a Metro Train Driver.

Metro Train Drivers

Since embarking on the abovementioned training programme the following number of Metro Train Drivers (Black) have been trained:

REGION	CURRENT NO OF TRAIN DRIVERS	NO OF TRAIN ASST IN TRAINING	NO. OF TRAIN DRIVERS IN TRAINING	NO. OF FEMALE CANDIDATES IN TRAINING	NO. OF FEMALES QUALIFIED AS TRAIN DRIVERS	NO. OF METRO GUARDS IN TRAINING	NO. OF ACCELERATED PROGRAM TRAIN DRIVERS QUALIFIED
WITS	287	6	10	1	0	3	45
PRETORIA	128	4	4	0	1	0	21
CAPE TOWN	175	0	19	3	0	16	12
DURBAN	125	6	15	9	0	0	24
TOTAL	715	16	48	13	1	19	102

Road Knowledge

Road knowledge of the individual Train Driver is required regarding the location of signals and other variables that influence safe handling of the train. The following examples are typical aspects that a Train Driver encounters during driving.

1. Station names
2. Curves and landmarks
3. Signal and track side indicator positions
4. Gradients
5. Uni or bi-directional lines
6. Local instructions
7. Methods of Train Control.

Although some of these aspects are covered in the practical training constitutes such a vast number of facts to be memorised that a more intensive programme of training is required. This can be facilitated by the use of a dedicated training rail vehicle on the applicable line that is traversed by the student. This training is considered crucial and a 100% pass rate is required.

CLOSING REMARKS

Metrorail is in the process of introducing this type of training in order to fill any gap that might exist in the training programme. The success rate of training of Metrorail train Drivers appears to be of a high standard and only three (3) serious transgressions have been reported since inception. The proposed road knowledge programme could possibly provide the bridging required to fill the gap. Uniform safety standards are utilised by Metrorail as a Business Unit of Transnet which also ensures that a working environment in harmony with other rail operators is obtained.

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Towards Safe Norms in Train Control Systems

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- Joined SPOORNET in 1991 as part of a professional team responsible for Employee Well-being.
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THE INTERNATIONAL RAILWAY SAFETY CONFERENCE: 1999

TOWARDS SAFE NORMS IN TRAIN CONTROL SYSTEMS

(A PAPER PRESENTED FOR THE PLENARY SESSIONS)

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SPOORNET

TOWARDS SAFE NORMS IN TRAIN CONTROL SYSTEMS

1. INTRODUCTION

This project is currently in progress in SPOORNET. The aim of this discussion is to use this forum as a learning experience and to obtain information from other Railway companies regarding the following:

- Are other Railway companies faced with similar challenges?
- Do safe norms in terms of workload for Train Control Systems or Train Control Officers (TCO) exist?
- Have any similar studies been embarked on?
- Are there any suggestions or potential pitfalls that should be borne in mind when conducting this study?

2. TRAIN CONTROL SYSTEMS IN THE SPOORNET CONTEXT

SPOORNET utilizes more than one train control system. This is due to historical and financial considerations, density of train traffic on a specific section and the availability of affordable technology.

The following Train Control Systems are being used:

- Train Staff and Paper ticket
- Van Schoor
- Radio Train Orders
- Track Warrant
- Colour Lights

3. THE MENTAL WORKLOAD ASSESSMENT PROJECT

The focus of the mental workload assessment project is on the radio train orders and track warrant train control systems. The eventual aim of the project is to develop generic criteria, which can serve as indications of mental workload and that can be used to determine safe norms for train control officers.

3.1 Definitions

Mental workload falls within the ambit of Ergonomics. A wide view is that ergonomics is the "study of human abilities and characteristics which affect the design of equipment, systems and jobs....and its aims are to improve efficiency, safety and....well-being (Clark & Corlett, 1984).

Mental workload is a complex concept due to its multifaceted nature. The conditions for operator overload are difficult to predict, despite the importance of doing so for both the safety of the operator and the consequences of task errors. The human subsystems involved include the perceptual, neuromotor and biomechanical ones, in which the field of Ergonomics has an extensive database and fairly well established prescriptions for successful designs or remedies. But also involved are the more psychological attributes such as: motivation, anticipation, skill and fatigue. These greatly complicate the picture and often bring the level of applied workload technology from "good standard practice" to "an erratic art" (Jex, 1981).

Meister (1985) defines mental workload as follows:

> "Workload is (also) the operator's internal experience of difficulty and discomfort, his recognition that he is experiencing a load and his strategy to overcome it."

This internal experience of difficulty and discomfort is the foundation for the stress created by mental workload. This stress is in most cases, and especially in the case of TCOs, a time related factor. In this regard Meister (1985) makes the following enlightening comments:

"Workload is based on two concepts:

- Tasks must be performed in a certain length of time, the degree of workload is the percent of time which the operator actually has to perform those tasks. This refers to time availability.
- The operator has only a limited capacity, usually conceptualized in terms of attention. When the operator must perform multiple tasks in the same period, there is competition among the tasks for his attention. The competition "loads" the operator. This refers to the degree of loading in terms of attention-per-task per operator."

The two train control systems which is the focus of the current project, will be discussed separately:

4. PROJECT 1: Radio Train Orders

4.1 Problem statement

A concern was raised that the current norm for radio train orders was not based on a valid mental workload assessment of the TCOs dealing with radio train orders.

Currently the norm for the number of radio train orders that should be handled by the TCO is determined by means of a formula that was developed a number of years ago. As far as could be ascertained, no validation studies were ever made to prove the validity of this method.

The formula currently used to calculate the maximum workload a TCO dealing with radio train orders should handle is:

Number of Trains x Number of order stations calculated over a 24 hour period =100 hours

If the ratio thus calculated exceeds 100, it was arbitrarily considered to be a high workload for the TCO.

In practice however the calculated number often exceeds 300 or more and an experienced operator can then still handle the situation comfortably.

On analyzing this formula, some issues were detected that supported the concern that was raised regarding the validity of the formula, i.e:

- The fundamental problem with the current method is that it is calculated over a 24-hour period and does not consider the number and length of shifts. A 24-hour period can consist of 2 or 3 shifts.

- In the different shifts there are different operators and the frequency of trains over the shifts is not evenly distributed.

- The norm of 100 for a heavy workload has not been validated in any way as far as could be ascertained. It is then still an open question what constitutes a heavy workload.

- It also seems unlikely that all the relevant factors that contribute to workload have been included in the method.

- No scientific proof exists that the current method criterion is valid (meaning that it actually measures workload).

4.2 Methodology

4.2.1 Task Analysis

A task analysis of the TCO job was done by means of task observation. The following tasks/ activities were identified:

- Planning of the shift activities
- Plot train schedules on train diagram
- Control of train movements by: Radio communication with train drivers
  Monitors al other radio conversations
  Receives request for a train order
  Makes out a train order
  Communicates train order and confirm
  Updates train diagram

- Answers telephone calls
- Writes reports
- Use of discretionary time

4.2.2 Time Line Analysis

"Time line analysis examines the temporal relationship among tasks and the duration of individual tasks." (Meister, 1985)

Time line analysis is thus a method of monitoring over a period of time, e.g. a shift, of how much time is devoted to which activities in a particular task. The time line analysis is important in mental workload assessment for a number of reasons:

- It forces the analyst to break down a job in all its different tasks and activities.

- It gives an indication of how much time is devoted to a particular activity/ task.

- It gives an indication of how much time in total has been taken up by the task during a certain period of work.

- The most important value of a time line analysis is that it gives an indication of tasks/ activities that simultaneously lay claim on the attention of the operator.

4.2.3 Proposed elements for determining workload norms

As stated in the first paragraph of this paper, this is work in progress.

The current formula/method consists of only three variables:

- The **number of trains**
- The **number of train orders**
- Over a **24-hour** period

Based on the task analysis of the TCO and the information from the time line analysis, it was concluded that the following elements be included in a formula to determine TCO workload and norms:

- The **number of trains** authorized per shift
- The **number of train order stations**
- The **number of official telephone calls** handled
- The TCO is expected to use the above information to make a **discretionary decision** to optimize the productivity of the system, manage the time of train personnel to adhere to legislation and to optimize fuel consumption.

- The number of train order stations should be weighed by a **difficulty factor**, as certain sections are more difficult than others
- There should be a **weighing factor for the particular shift** that the operator is working to accommodate the difficulties imposed by certain types of shifts.
- The **abnormalities** (such as technical problems on the train) that the TCO has to absorb.
- The method should be restricted to **the shift** (8 or 12 hours) the TCO was working and not be calculated over a 24-hour period.

4.2.4 Proposed further steps

- Complete time line analysis (TLA) of a representative number of radio train order centres and shifts.
- Obtain radio and telephone recordings and superimpose it on the TLA.
- Scrutinize the TLA`s to gain information of the loading of different elements and were bottlenecks tend to occur.
- Through multi-criteria decision modeling and expert analysis weigh the different factors.
- Categorize sections in low, medium and high workload.
- Develop method.
- Apply method on low, medium and high workload sections to test the discriminatory ability of the method.
- Validation study to establish valid criteria for mental workload.

5. PROJECT 2: Introduction of a Track Warrant system on the Sishen-Saldanha Line

5.1 Problem statement

After a recent accident, when a motor vehicle trolley collided with the back of a train, a concern was raised about the current train control system in use on this busy line. The method of train control is a combination of radio authorizations and colour light signals.

The Sishen-Saldanha line is 860 km long and is South Africa's iron ore export line. Iron ore is mined at Sishen and then transported to Saldanha, the harbour from where the ore is exported. It is a single track with 12 passing loops. The ore train consists of 200 wagons and is over 2 km long. Motor trolley vehicles inspect the track for any damages, such as broken rail. The trolley is sent in after the train and follows on a separate authority behind the train.

5.2 Methodology

5.2.1 Ergonomic evaluation of the train control centre

An Ergonomist performed an ergonomic evaluation of the centre where the TCO performs his duties. The centre also accommodates the train control Co-ordinator, Train Planner, Data Clerk and the electrical monitoring personnel. The ergonomic evaluation provides the task context for the mental workload of the TCO.

Several ergonomic shortcomings were identified which could contribute to the mental workload of the TCO and therefore to his level of fatigue.

5.2.2 Task analysis

A task analysis was performed by observation of the TCO over a period of 6 hours. The task analysis provides the task content for the mental workload assessment.

The following tasks/activities of the TCO were identified:
- Updating of scheduled train and maintenance equipment movements on the line on the train diagram. (One TCO is responsible for all movements over the total of 860 km of track.)
- Issuing of authorities for train movements by radio.
- Controls motor vehicle trolley movements.
- Controlling of colour light signals by means of a computer for all train crossings at loops.
- Monitors 3 maintenance radios.
- Issuing of warnings to work teams and train drivers of any perceived hazardous situation.
- Provides data clerk with relevant information about train movements.
- Solving of problems such as:
  - Delays and the expected consequences
  - Accidents
  - Small technical problems
- Answering telephonic enquiries.

The following Task Content Stress Factors were identified and are construed to be risk factors which could add to the TCO's level of stress and lead to increased mental workload:

- The number of trains to be handled.
- A continuous high volume of work over the major part of the shift in which the TCO has very little opportunity to do anything else but to concentrate on his work.
- More than one radio call coming in simultaneously.
- Radio and telephone calls coming in simultaneously.
- Trains that are running late due to technical or operational problems.

- Technical problems unrelated to the task of the TCO are directed at him, as he is the only person in contact with the train driver.
- The necessity to be aware of the risk to all work teams on the line and to warn them in time of any dangerous situations. This responsibility adds to the level of stress.
- The continuous switching from one train to the next. No opportunity to complete one task and then concentrate on the next.
- Train drivers getting impatient with the TCO due to stresses he has to cope with (such as being delayed, technical problems).

5.2.3 Proposed further steps

- The ergonomic design of train control centres is a priority. The following aspects should be addressed in the design:
  - Noise in the work area
  - Controlled access to area
  - The ergonomic outlay of the work area such as height of desk, chair, light intensity, temperature
  - The distance of the visual display units from the operator should be at the resting position of binocular convergence.
  - Head sets for telephones.
- The responsibility that the TCO carries adds to the mental workload and available technology should be used to assist the TCO. The following are part of the TCOs responsibilities: High density of train traffic, maintenance teams and machines and motor trolleys. The activities of all these groups are monitored by the TCO and separate authorities given to all movements. The already heavy workload could be alleviated, especially the stress created by the responsibility, by giving the TCO some assistance in his decision-making.
- There are also certain environmental factors such as vandalism and the high maintenance cost of certain systems and the failure of train control systems that emphasize the need to change the system.

The Task at hand for the Project team is:

- To investigate the feasibility of introducing a track warrant system on this line and then to develop implementation criteria
- To determine safe norms for TCO`s working with track warrant in terms of mental workload.

Closing comments

The Project team is in the process of developing a formula to determine safe norms for the track warrant train control system. An invitation is extended to all delegates who have dealt with similar situations or who might have embarked on similar investigations to attend the discussion and share your knowledge and experience with us.

International Rail Safety Conference

1999 BANFF

19 October - 22 October 1999
Banff Springs Hotel, Banff National Park, Alberta, Canada

Paper 9937

F. K. Turner

Some Things Never Change

Publisher
2000 International Rail Safety Conference

AMERICAN SHORT LINE AND
REGIONAL RAILROAD ASSOCIATION

The Voice of America's Independent Railroads

Frank K. Turner
President
American Short Line and Regional Railroad Association

Frank Turner became President of American Short Line and Regional Railroad Association (ASLRRA) on January 1, 1999. ASLRRA is a trade association that represents 425 short line and regional railroads which provide local rail service in all sections of the country. Mr. Turner represents the interests of these railroads before Congress, Federal and State regulatory agencies and on the policy and technical committees of the U.S. railroad industry. The association also serves as a liaison between its member railroads and the large railroads of this nation.

Prior to this recent assignment he held several key positions at CSX the last being Vice President of Operations for CSX Intermodal. Before joining CSX in 1993 Mr. Turner was President and Chief Operating Officer of Midsouth Railroad where he had been since 1988. Prior to 1988 he was a key operating officer with the Norfolk and Southern Railway where he had been employed since 1969.

He is a graduate of New Mexico Military Institute and Texas A&M University at Commerce. He also served as an officer in the U.S. Marine Corps for 8 years and is a Vietnam veteran.

He and his wife, Rosalie, reside in Gainesville, Virginia.

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Some Things Never Change

F.K. Turner
President

American Short Line And Regional Railroad Association

I am a third generation railroader so railroad safety has been more to me than just an assigned task at work. I can honestly say no matter what my job has been in this industry, safety was always at the top. I have enjoyed some success in my safety endeavors. As a railroad division superintendent on three different divisions, two of the divisions were recognized as being the safest and third division had an improvement of their safety record of 26%. While president of a midsize railroad the injury frequency index improved from 8.0 to .9, during this time we were recipients of two Harrimon Awards. As Vice President of Field Operations for CSXT we enjoyed the best safety record ever on that railroad. While as Vice President for CSX Intermodal the safety record improved more than any other department on the railroad.

Now for the rest of the story. During all of this time employees for whose safety I was responsible suffered from broken bones, loss of limbs, severe back injuries, cuts, bumps, bruises, and loss of life. Nothing in my railroad career has given me any more satisfaction and ,at the same time, more frustration, than has the safe conduct of employees for whom I have been responsible. The goal of safety has to be the safe return home of each and every employee after each and every tour of duty. Growing up in a railroad family, whose father and grandfather were in train service I never realized how important railroad safety was to my well being. My father worked 47 years without an injury.

When I began in this industry over thirty years ago there were 71 major railroads. Today there are but eight. This fact alone really symbolizes the many changes we have had in our industry. I think it is very safe to say that we are now a "tech" industry. The difficulty in recent mergers points this out. We have changed locomotives from D.C.

current to A.C. current, resulting in greater locomotive efficiency. Track gangs are now mechanized. Labor agreements allow two men crews. Deregulation allows railroads to do their own pricing, to list just a few of the many changes in our industry.

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 safe, 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. That certainly includes insuring all injuries are reported. While management has the responsibility to teach the rules, labor can certainly be good teachers, also. Labor can be good teachers by challenging management as to the understanding of safety and operating rules. An environment that encourages a good healthy discussion of safety and operating rules will pay great dividends.

Obviously a thorough knowledge of the rules is only the beginning. How do we insure a willingness to comply with the rules? As previously mentioned management has to set the example. Management has to be present in the field to observe and coach if necessary. Management also has to occasionally "hide in the weeds" to insure rules are being complied with. To those that would argue this is unnecessary I would ask, don't you think the fact that on a highway you may at any moment encounter a patrolman with a radar gun has something to do with speed control?

It is how we handle the results of the observation that is important. First, when the employees are strictly adhering to rules and under observation they should be commended for their actions. When employees, for whatever reason, choose not to comply with safety and operating rules, then what?

The stock answer is that discipline has to ensue. I'm not sure we clearly understand the real meaning of discipline.

Shortly after the end of the Korean War as a young teenager I had a conversation with a Marine who had just returned from combat duty there. I asked him why he joined the Marine Corps. His answer was that the discipline was such that you could depend on the person on your left and also on your right. That thought always stuck with me and influenced my decision to join the Marine Corp after college. In Vietnam I found that understanding of discipline to be true. This is what we want in a railroad operating environment to be able to depend on the person to the left and right of us.

Discipline has many meanings according to Webster. It can mean "a rule or system of rules governing conduct", or it can mean "to train or develop by instruction and exercise especially in self control", or it can also mean "to punish or penalize for the sake of discipline". Too often we only think of the last definition. All three definitions have an application in our rules compliance, to "train" to "exercise" and "penalize". Training begins the 1st day of employment and continues until the last. Exercise is the day to day compliance of safety and operating rules.

When we must "penalize" for rule compliance failure we must administer it fairly and progressively and not as a retaliatory measure. To be fair in administrating discipline, management must know the safety and operating rules. The penalty part of the process is not easy, but it is necessary in the event of a failure to comply with the rules.

A disciplined rules culture will not be created without strong leadership. While management is ultimate responsible for leadership, this can certainly be shared throughout the ranks. Many employees have responsible jobs away from the railroad such as railroad ie, PTA, church, Little League etc. Why not utilize their talent. Sometime a "born again" sandhouse radical will see the light. Certainly union leadership should be encouraged to lead in creating a rules compliant environment.

The greatest reward of a safe culture is the return each day of the employee to his or her family. There can be other rewards such as recognizing individuals, shops, terminals, divisions and railroads for outstanding safety. The safety program can not be a safety contest where the fear of losing jeopardizes the integrity of the effort.

The ABCD of a successful safety culture are as follows:

Always Integrity

Be Sincere

Create Knowledge

Do Hard Work

Nothing I have written here today is new. It is merely remembering what has worked and what hasn't worked in attempting to create a rule compliant environment where each employee returns safely home after each work day. That after all is our ultimate goal.

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Jeff Moller

Fatigue Countermeasures Programs on North American Railroads
A brief history

Publisher
2000 International Rail Safety Conference

Fatigue Countermeasures Programs on North American Railroads - a Brief History

Presented to
1999 International Safety Conference
Banff, Alberta

Jeff Moller
Director Casualty Prevention
Association of American Railroads

COMMISSION OF INQUIRY
HINTON TRAIN COLLISION

REPORT OF THE COMMISSIONER
THE HONOURABLE MR. JUSTICE RENÉ P. FOISY
DECEMBER, 1986

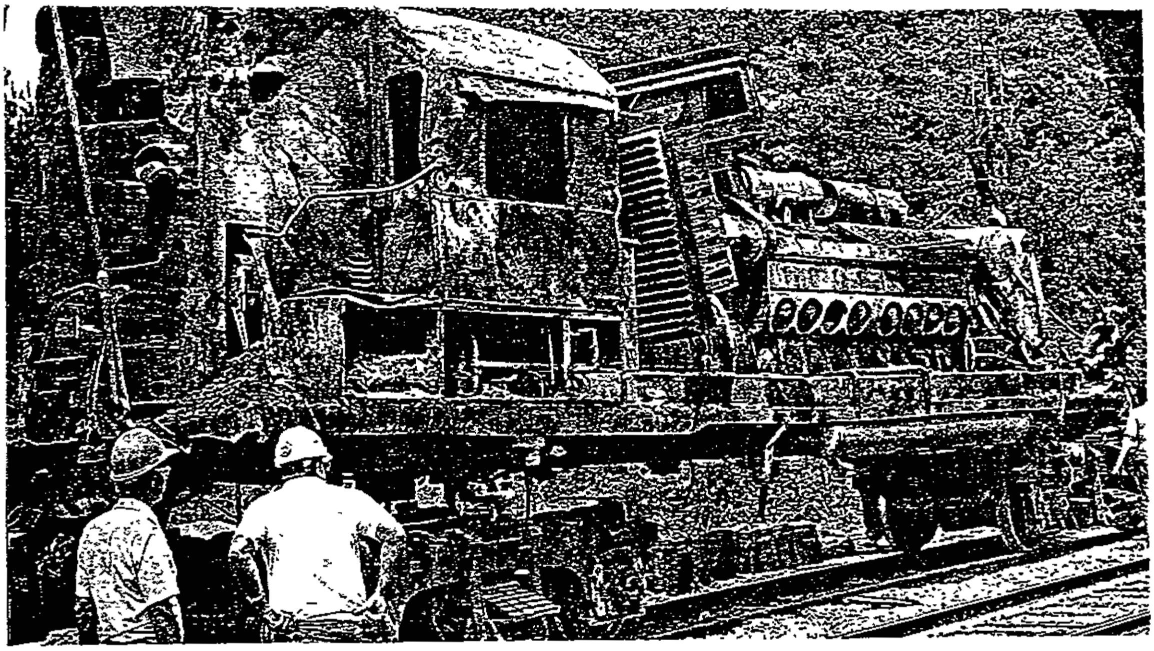

Figure 4.--Two photos of damage to the locomotive of train G-38.

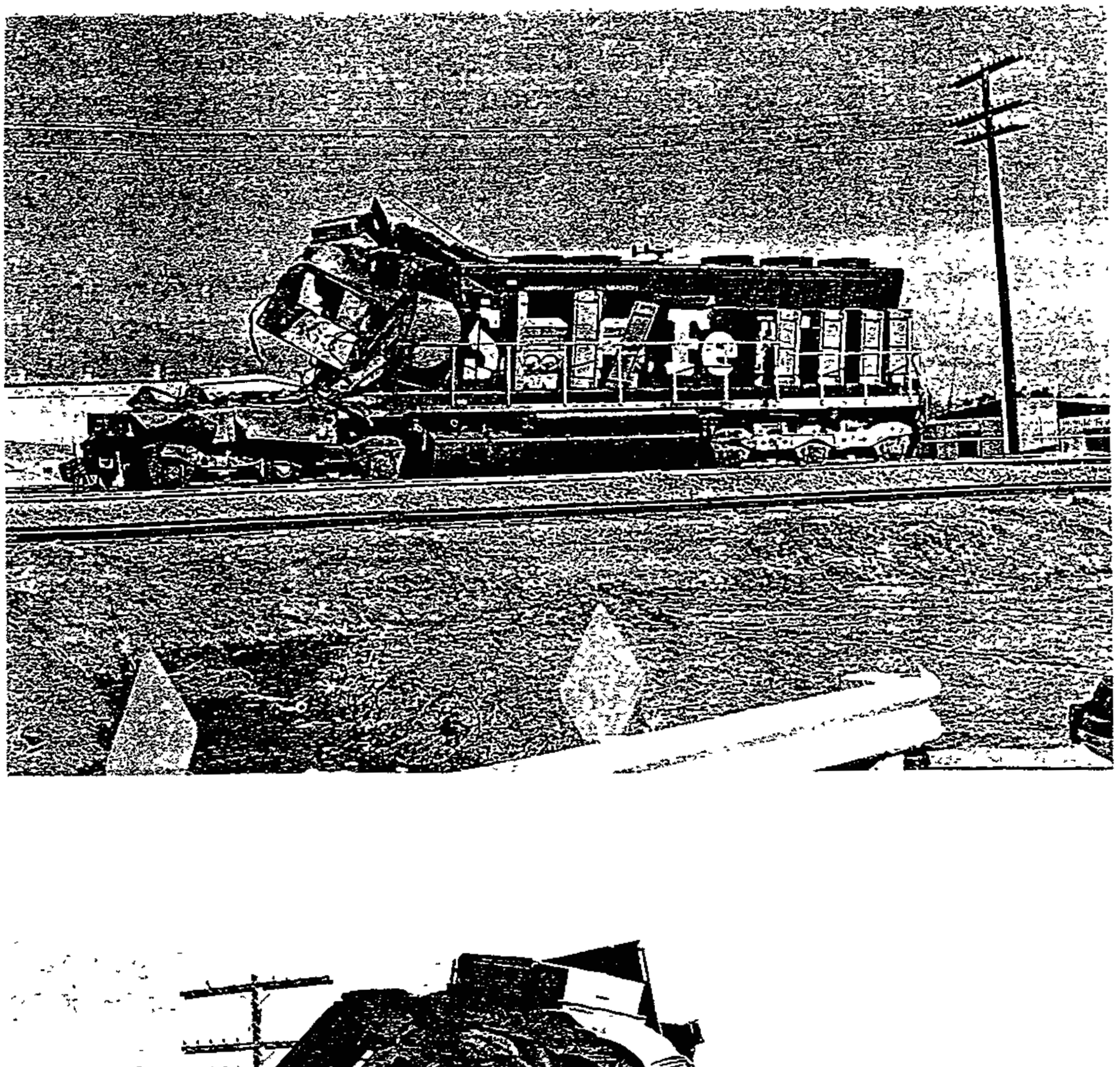

Figure 6.--Postaccident photographs of train 818's lead locomotive.

	From Hobart Yard							From Barstow			
Day	Date	Reporting Time	Time on Duty			Day	Date	Reporting Time	Time on Duty		
			Hour	Min					Hour	Min	
Wed	5-Sep	5:00 AM	5	35		Wed	5-Sep	11:45 PM	8	40	
Fri	7-Sep	4:45 AM	7	30		Sat	8-Sep	3:15 PM	2	30	
						Sun	9-Sep	4:15 AM	6	30	
Mon	10-Sep	12:15 PM	5	30		Tue	11-Sep	8:15 AM	6	30	
Wed	12-Sep	11:00 AM	8	5		Thu	13-Sep	7:30 AM	6	30	
Fri	14-Sep	5:15 PM	5	15		Sat	15-Sep	1:15 PM	6	30	
Sun	16-Sep	Called 1449	Laid Off On Call								
Mon	17-Sep	8:30 PM	2	10	Dead Head	Tue	18-Sep	8:00 AM	6	40	
Thu	20-Sep	3:15 PM	8	50	Yard Job						
Sat	22-Sep	4:15 AM	7	25		Sat	22-Sep	11:45 PM	5	45	
Sun	23-Sep	5:15 PM	5	30		Mon	24-Sep	6:45 AM	7	0	
Tue	25-Sep	7:05 AM	12	0							
Thu	27-Sep	4:15 AM	6	0		Fri	28-Sep	2:15 AM	7	45	
Sat	29-Sep	Called 1139	Laid Off Sick								
Tue	2-Oct	10:00 AM	12	0							
Thu	4-Oct	4:30 AM	9	30		Fri	5-Oct	3:45 AM	3	15	Dead Head
Fri	5-Oct	3:15 PM	8	0	Yard Job						
Sat	6-Oct	Called 0415	Laid Off On Call								
Sun	7-Oct	3:15 PM	8	0	Yard Job						
Tue	9-Oct	2:00 AM	4	50		Tue	9-Oct	4:15 PM	2	20	Dead Head
Thu	11-Oct	12:30 AM	4	0	Dead Head	Thu	11-Oct	7:15 PM	2	30	Dead Head
Fri	12-Oct	10:00 PM	2	20	Dead Head	Sat	13-Oct	8:45 AM	6	45	
Sun	14-Oct	11:00 PM	2	30	Dead Head	Mon	15-Oct	5:15 PM	6	30	
Wed	17-Oct	4:15 AM	10	0		Thu	18-Oct	12:15 AM	5	45	
Fri	19-Oct	4:30 AM	10	0		Sat	20-Oct	3:20 AM	5	25	
Sun	21-Oct	4:30 PM	5	45		Mon	22-Oct	8:45 AM	7	15	
Tue	23-Oct	5:15 PM	5	0		Wed	24-Oct	12:15 AM	5	0	
Thu	25-Oct	Called 3:00 AM	Laid Off Personal								
Sat	27-Oct	4:30 AM	7	0		Sun	28-Oct	12:15 AM	8	5	
Mon	29-Oct	11:00 AM	6	15		Tue	30-Oct	1:15 AM	6	55	
Wed	31-Oct	4:15 AM	8	30		Thu	1-Nov	12:01 AM	7	0	
Fri	2-Nov	12:15 AM	7	25		Fri	2-Nov	3:45 PM	6	30	
Sat	3-Nov	10:30 PM	6	50		Sun	4-Nov	6:45 PM	12	0	
Tue	6-Nov	4:30 AM	8	10		Tue	6-Nov	10:15 PM	Collision At Corona at 4:10 AM		
Source : ATSF										Chart By NTSB	

Figure 5.-- Reporting times for the engineer of train 818 at Hobart Yard and Barstow.

Work / Rest Task Force Formed in Mid - 1992

- Association of American Railroads
- Brotherhood of Locomotive Engineers
- Burlington Northern Railroad
- CONRAIL
- CSX Transportation
- Illinois Central Railroad
- Union Pacific Railroad
- United Transportation Union

Task Force Research

1. To develop a set of measurable factors associated with railroad crew member work schedules and to describe crew member work schedules in terms of these measurable factors.

2. To determine what relationship, if any, exists between the above set of measurable work schedule factors and the occurrence of incidents

Task Force conducted extensive review of crew schedule characteristics - comparing schedules of employees who were involved in an "incident" with those who were not. An incident was a FRA-reportable human factors accident, a personal injury or a rules violation

Three parameters used to evaluate schedules:

- Shift Density
- Shift Length
- Schedule Variability

Based on a review of more than 800,000 crew starts, a series of working conclusions presented in November 1994.

Preliminary Conclusions Published 11/94

Between midnight and 6:00 a.m., the potential for accidents increases when a train and engine crew has been on duty for greater than nine hours.

The potential for an incident increases when a train or engine service employee has worked:

- Five consecutive permissible shifts with an average shift length greater than 10 hours.
- More than 6 consecutive permissible starts in a seven day period.

WORK/REST TASK FORCE

Initial effort - attempt to relate quantifiable shift characteristics to accidents, incidents, and rule violations.

• Shift Length • Shift Density • Shift Variability	=	COMBINED SHIFT FACTOR

The only research in the <u>transportation</u> industry that is attempting to quantify fatigue. (Rosekind, NASA/Ames, Dinges, Univ. of PA)

CONCLUSION

After evaluating over 5 million engineer starts:

- While data continues to suggest a relationship between incidents and schedule difficulty, work schedule information does not appear to be a predictor of incidents.

- Engineers at various terminals may not consistently work the same territories

- No "one size fits all" solution

CANALERT

- CN - CP - BLE - Circadian Technologies

- Develop, validate, and implement a set of fatigue countermeasures (technologies, rules, procedures and practices) to accomplish:

  - Employees commencing duty be rested and alert
  - Alertness be sustained throughout the duty period
  - Permit employees to meet their personal needs
  - Railroads meet service objectives and implement change

CANALERT Countermeasure Development

- Time pool scheduling
- Bunkhouse improvements
- Locomotive cab audio system
- Napping Policy
- Lifestyle Training

CANALERT Initial Study Results

TIMEPOOLS

- Over 80% positive reaction
- Absenteeism fell 60% at CP and 56% at CN
- Operational problems reduced an estimated 60% at CN

BUNKHOUSE IMPROVEMENTS

- Restorative value of sleep statistically enhanced at one group, no change in other group

LOCOMOTIVE CAB AUDIO SYSTEM

- Alertness significantly increased

NAPPING POLICY

- Smooth, issue free
- Used less frequently than anticipated
- "Nodding off" decreased 30-38% on CP and 16-23% on CN

LIFESTYLE TRAINING

- 4-hour session - well received
- Approximately half made changes in lifestyle and sleeping strategies

IMPAC

CR - BLE - UTU

- Two locations - Elkhart - Chicago (75 miles)
  Buffalo - Toledo (300 miles)
- Short Pool
  - Minimum 10 hours undisturbed rest - home and away
  - 14 hours away-from-home maximum rest
  - Scheduled days off (4 days/month)
  - Napping policy on trains
  - Napping facility at home terminal
  - Sleep disorder screening and treatment
  - Lifestyle training for employees and families

IMPAC

- Long Pool (Buffalo - Toledo)
  - Assigned trains or assignments for a block of time
  - Assigned days off (4 days/month)
  - Noise-reducing radio sets
  - Back exerciser
  - Napping facility at terminals
  - Sleep disorder screening and treatment
  - Lifestyle training for employees and families

BNSF Spokane Project

Spokane to Pasco Pool

- Time windows for pool crews - based on traffic forecast model
- Assigned days off for extra board - (8/3)

IMPROVED ALERTNESS

- Significant measurable improvement in alertness
- Significant increase in percentage getting more sleep in last 24 hours

IMPROVED QUALITY OF LIFE

- Significant increases in leisure time

BNSF Spokane Project

OPERATIONAL IMPROVEMENTS

- Significant reduction in absenteeism
- Increased crew utilization

Spokane crews voluntarily extended initial 90-day pilot an initial 30 days and then voted to terminate the project.

Current Work / Rest Task Force Work

- Scientific Advisory Panel
  - Dr. Greg Belenky, Walter Reed Army Institute of Research
  - Dr. Carlos Comperatore, Marine Safety Laboratory, USCG
  - Dr. Ron Heselgrave, University Health Network (Toronto)

- *Current Status of Fatigue Countermeasures in Railroad Industry*
  by Dr. Pat Sherry, University of Denver
  (www.du.edu/~psherry/fatigue/)

UTU / BLE NATIONAL AGREEMENT

"Achieve meaningful progress in addressing fatigue issues by mutual and cooperative actions."

- Work Rest Committees established on each carrier
- Education and training
- Committees to establish:
  - Assigned work and rest days
  - A minimum of eight hours undisturbed rest
  - 7:00 A.M. markups after 72+ hours leave
  - Increased assigned service
  - Prompt relief after 12 hours
  - Standards for lodging facilities
  - Improve accuracy of line ups

Examples of Current Countermeasures

- Education and Training for Employees and Families
- Scheduling
  - Time Pools, Assigned Work/Rest Days, Line-ups
- Sleep Disorder Screening
- Lodging Standards
- Alertness Strategies
  - Napping, Employee Empowerment
- Review of Countermeasure Effectiveness

North American Rail Alertness Partnership

- FRA
- Rail Management
- Rail Labor
- NTSB
- Transport Canada

- Quarterly meetings to share ideas, learn about current scientific developments and provide input to scientific research products

ANSWER

A Cooperative Effort Between Labor, Management, Government

AND

The Scientific Community to Address True Fatigue Issues

- FRA's *North American Rail Alertness Partnership*
- AAR's *Work/Rest Task Force*
- Various Efforts on Individual Properties
- National Collective Bargaining

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Paper 9939

Mrs Faye Ackermans

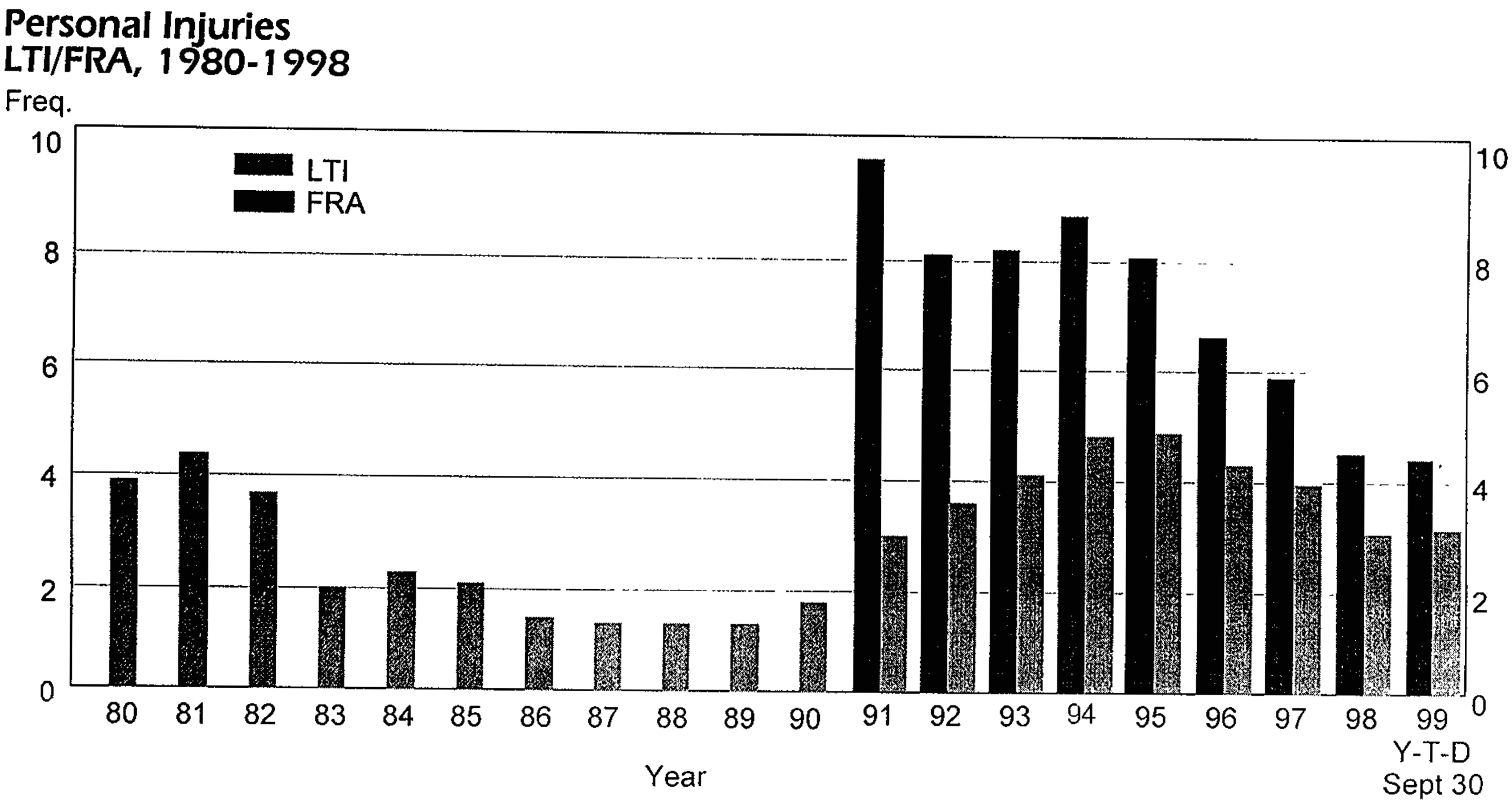
CPR - Safety Management Process

Publisher
2000 International Rail Safety Conference

Canadian Pacific Railway Safety Management Processes

CANADIAN
PACIFIC
RAILWAY

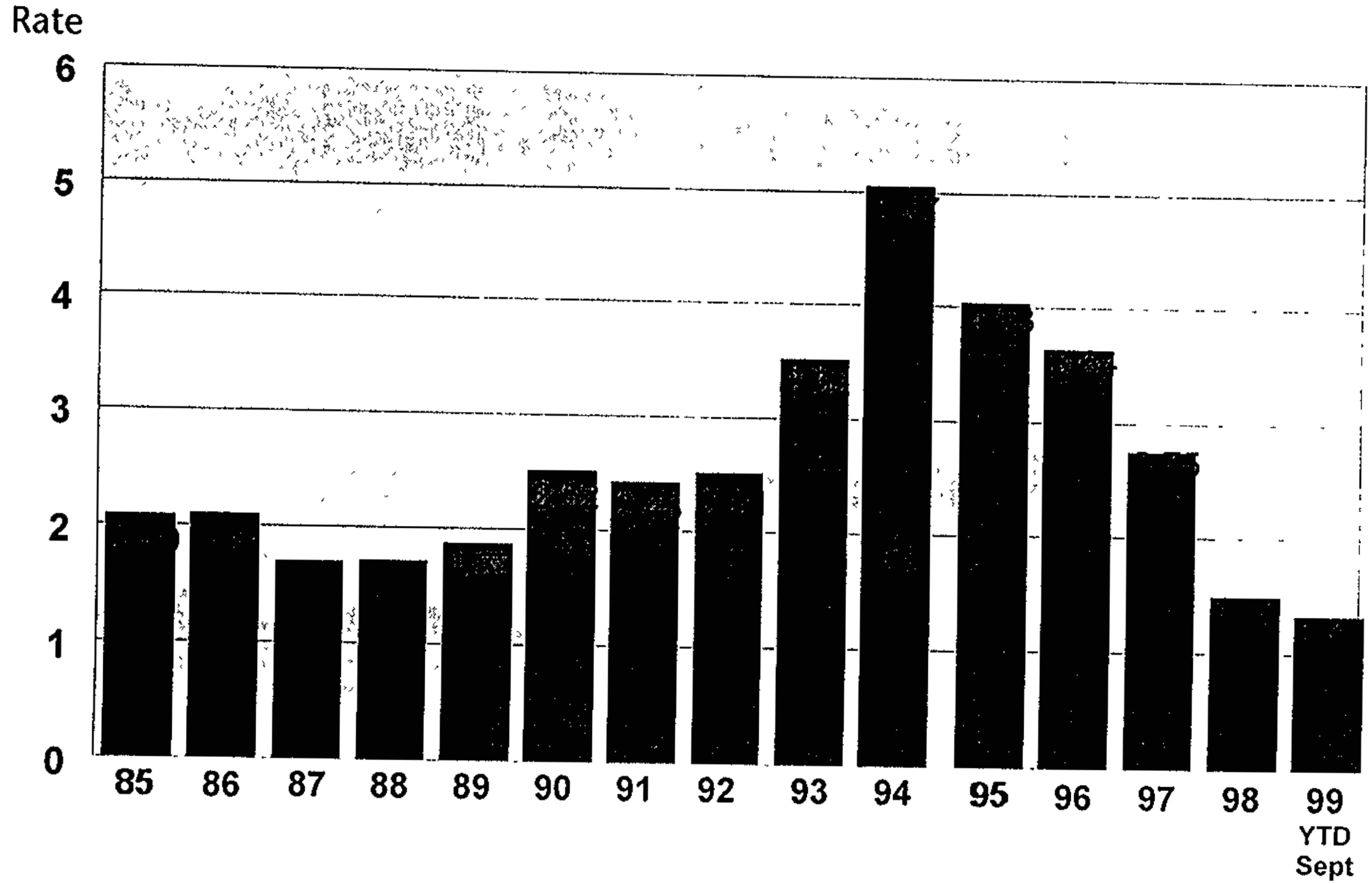
The Safety Trend Line – Historical Overview



Canadian Pacific Railway

The Safety Trend Line – Historical Overview

Train Accidents - Canada



Canadian Pacific Railway

Why Did We Need to Change?

- Accident and injury rates too high
- Insufficient employee participation
- Inconsistent application of program
- "Standards" varied
- Policies not understood or not followed
- Employee perceptions of safety management were low
- Safety was not well integrated into day-to-day processes
- Employee and manager "buy in" for safety lacking
- Processes varied from location to location

Guiding Principles

- Safety is an Integral part of the way we do business (safety must form a part of everything we do in our jobs)
- Safety principles apply regardless of the task to be performed
- We must set priorities for safety activities, based on risks involved
- Training is essential for safety
- Involvement from all levels is essential
- Safety communication must be free-flowing
- All elements of safety must be measurable
- Consistency is essential in the application of the process
- A safety action plan is essential

CPR's New Safety Process

- Safety Action Plans are built jointly by Employees & Management
- Plans built with Bottom-Up Philosophy
- Employees involved in the process from the time plans are developed through to monitoring and auditing stages
- Action Plans are based on needs

Employees Involved in Developing:

- Overall ***Goals*** based on statistical data and collective experience
- ***Activities*** to help achieve the goals
- ***Standards*** for the activities to ensure:
  - Employees are involved
  - Efforts are being communicated
  - The proper risks are addressed
  - All aspects of the activity are measurable

Three Main Stages of Development

- Planning Stage
- Monitoring Stage
- Improvement Stage

Planning Stage

- **Workshop**
- **Involvement**
  - S&H Committee Members
  - Employees
  - Managers
  - Supervisors

Planning Stage (cont'd)

- Examine what we are doing
- Evaluate strengths & weaknesses
- Determine improvement opportunities
- Develop strategies & implementation plan

Planning Stage

- Toward the end of the planning workshop, the group will develop a Time & Action Calendar which clearly states who will do what – by when. This is the main vehicle to bring the Action Plan to life

Control or Monitoring Stage

- **During the Control or Monitoring stage, the Safety & Health Committees play a vital role in supporting the process. *They***
  - review the plan regularly to ensure activities are being carried out as per activity standards and Time and Action Calendar
  - monitor injury trends and conditions through audits, inspections and statistical analysis
  - communicate to appropriate persons when plans are off target

Improve Stage

- **From time to time there may be a need to improve the safety plan**

  Committee members will:

  - review & change activities
  - review and improve standards
  - communicate revised plan
  - implement revised plan

Improve Stage *(cont'd)*

- **What triggers the Improvement Phase?**
  - serious injury or incident
  - injury or incident trend patterns
  - deviations from standard
  - goals off target

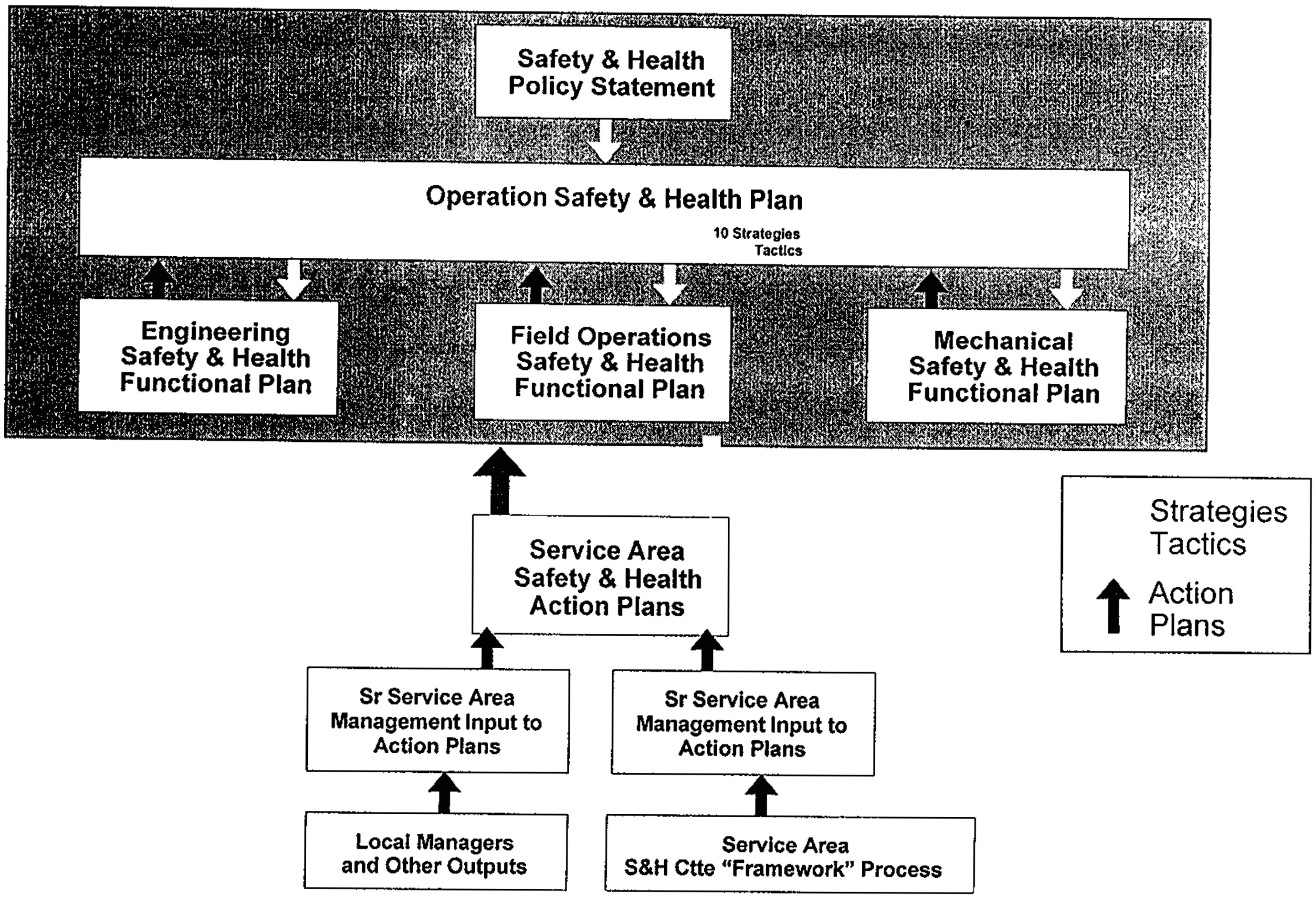
Safety Framework Outcomes

- **To achieve consistency in:**
  - how plans are developed
  - measurement tools
- **To Provide:**
  - activities that are target & goal oriented
  - employee involvement
  - ownership of safety
  - continuous improvements of the safety process

Safety Framework Process

"The Canadian Pacific Railway's Safety Framework is a tool that ensures the three fundamental steps of Planning, Monitoring and Improving are consistently present and applied across CPR to effectively manage risks and hazards. It focuses on continually improving the Safety Process, thus ensuring a safe and healthy work environment."

Safety Planning Processes

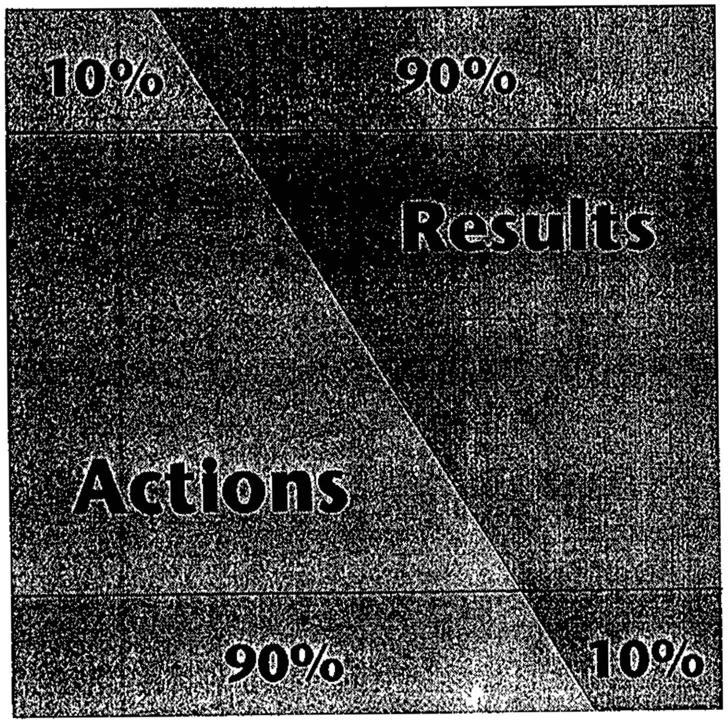


Employee Involvement is Key

Senior Managers –
Safety & Health Management Committees

- Meet weekly (90 minutes every Monday)
- 4-hour conference call – monthly
- 10 – 12 Safety "walkabouts" each year
- Special ad hoc business meetings to:
  - Policies
  - Plans / Performance target-setting
  - Safety Issues
  - Commitments

Safety Performance Tied to Monetary Incentives



Senior Managers

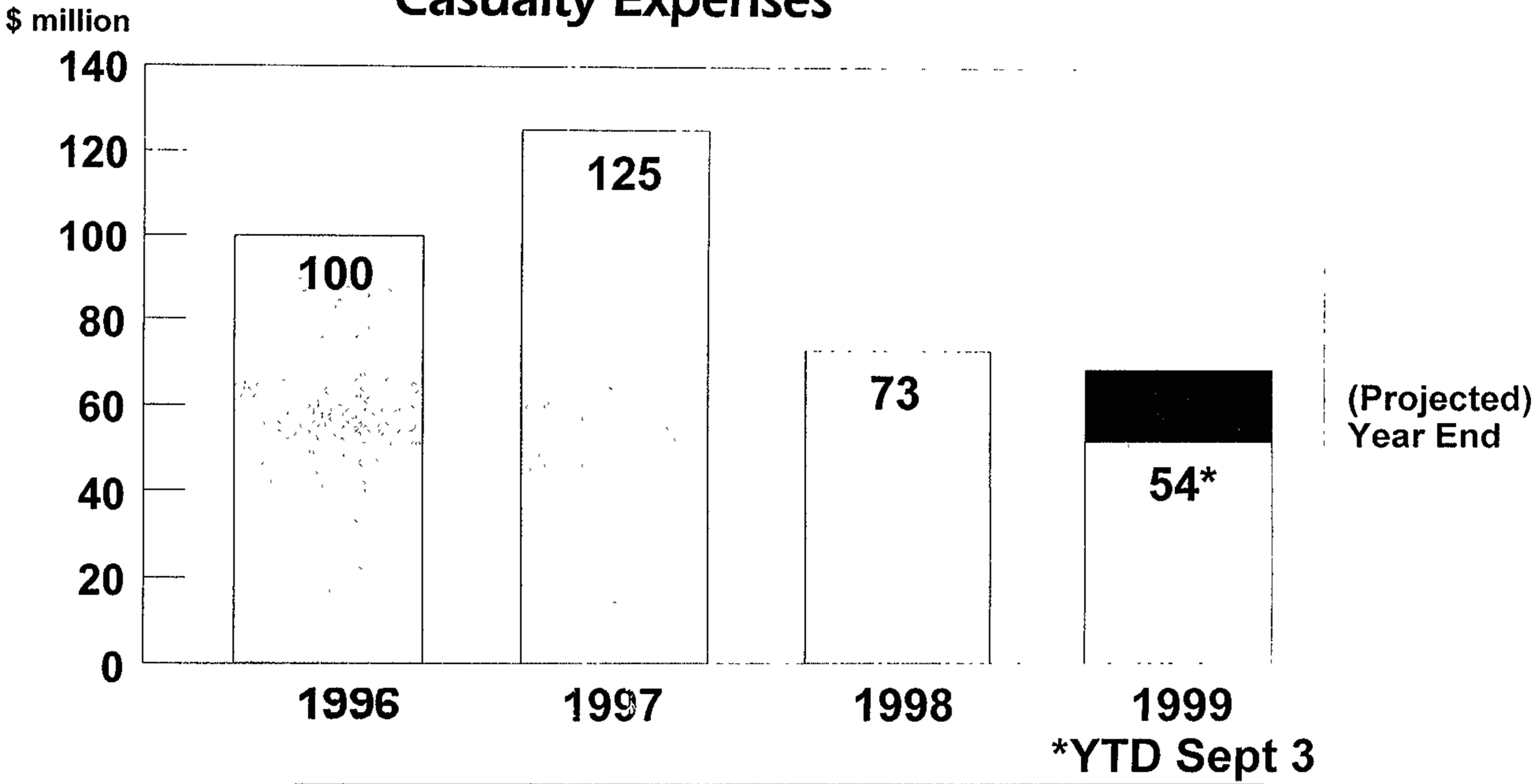
Front Line Supervisors

1998 Safety Results

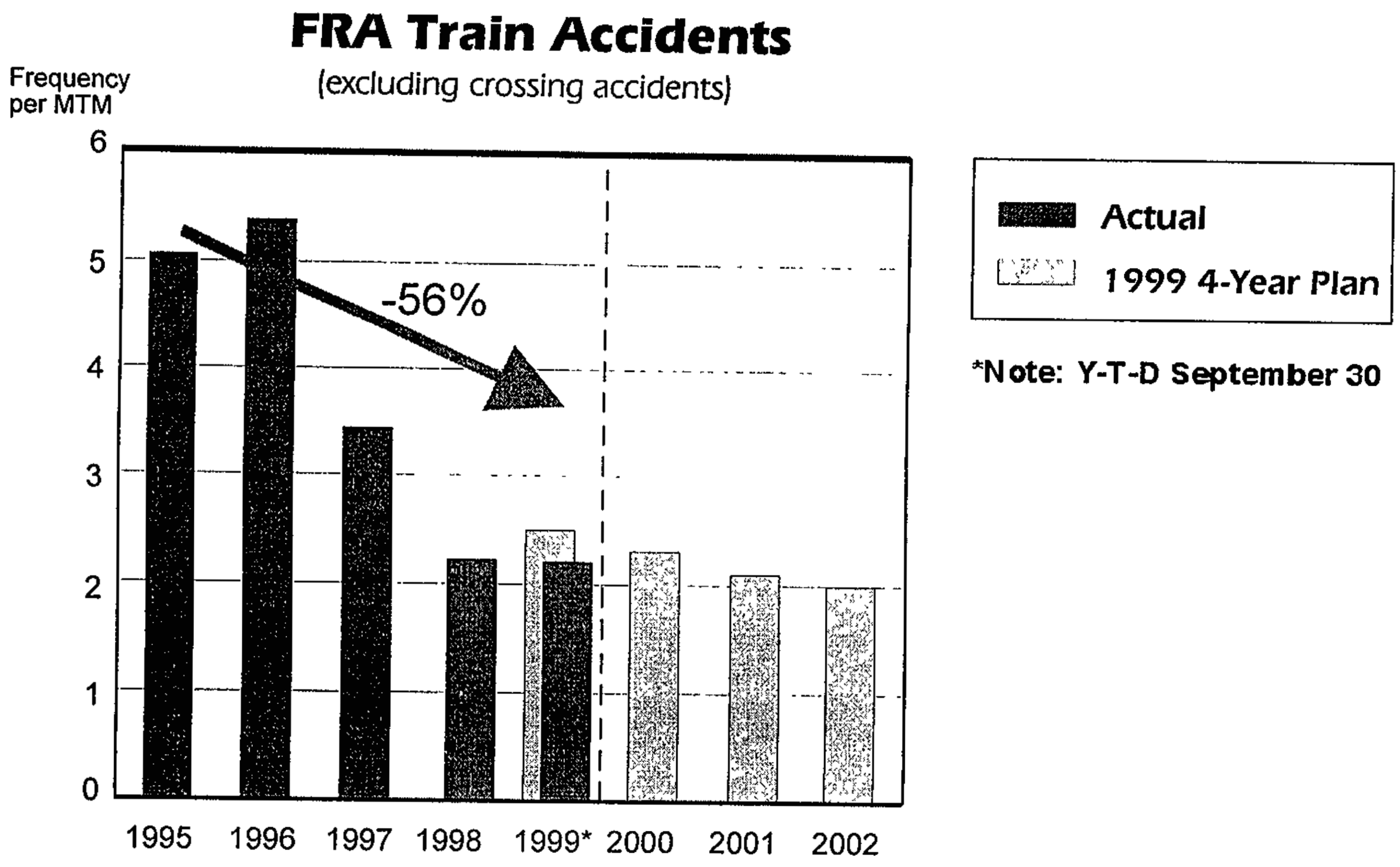
- Safest year in CPR history
- No employee or contractor employee fatalities
- Only four employees had major injuries
- Train accident frequency rate lower than US railroads
- Significant reduction in costs of accident / injuries
- Achievements recognized
  - Harriman Award
  - Public Safety – crossing collision

Safety Results

Casualty Expenses

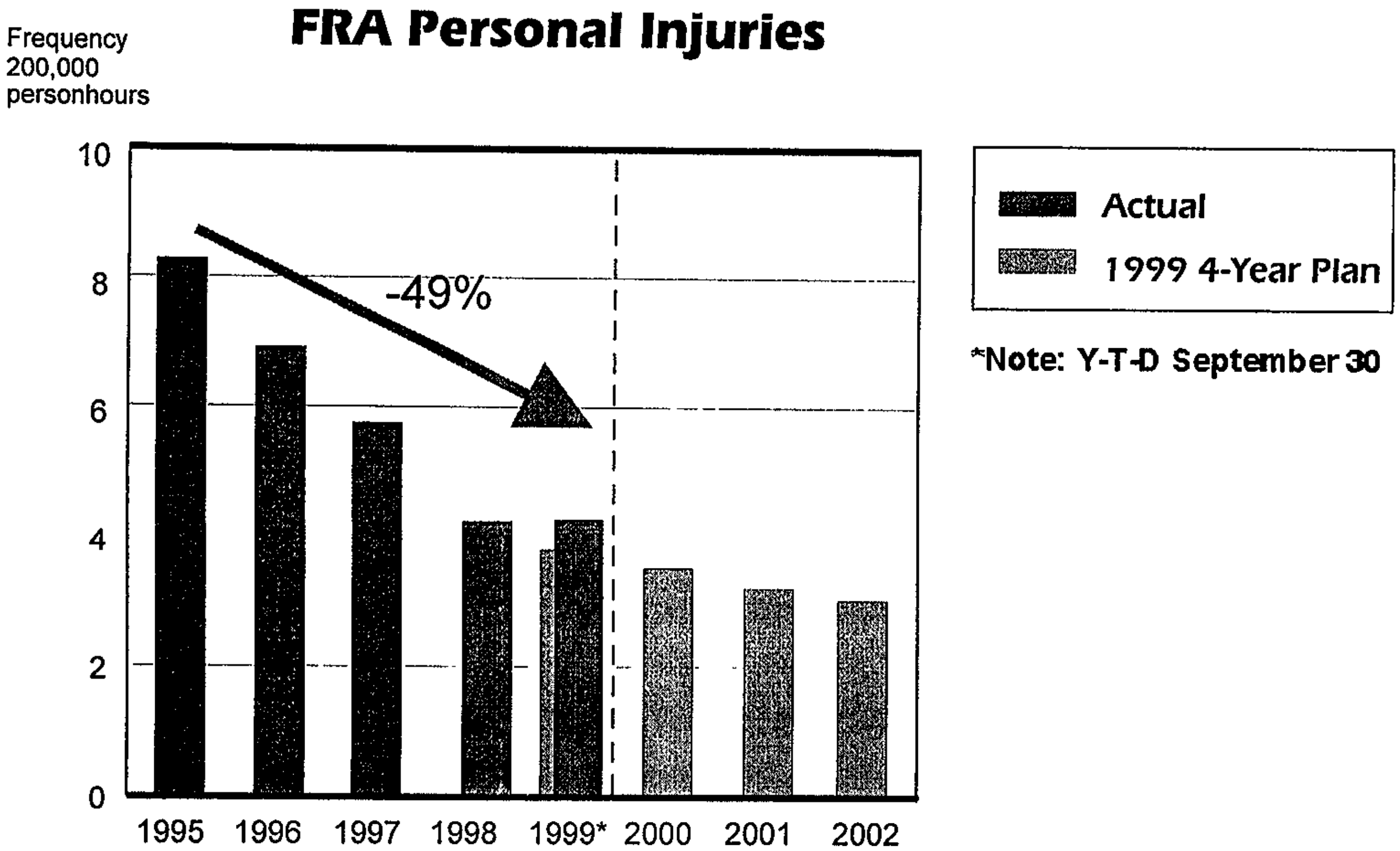


Safety Results



*Note: Y-T-D September 30

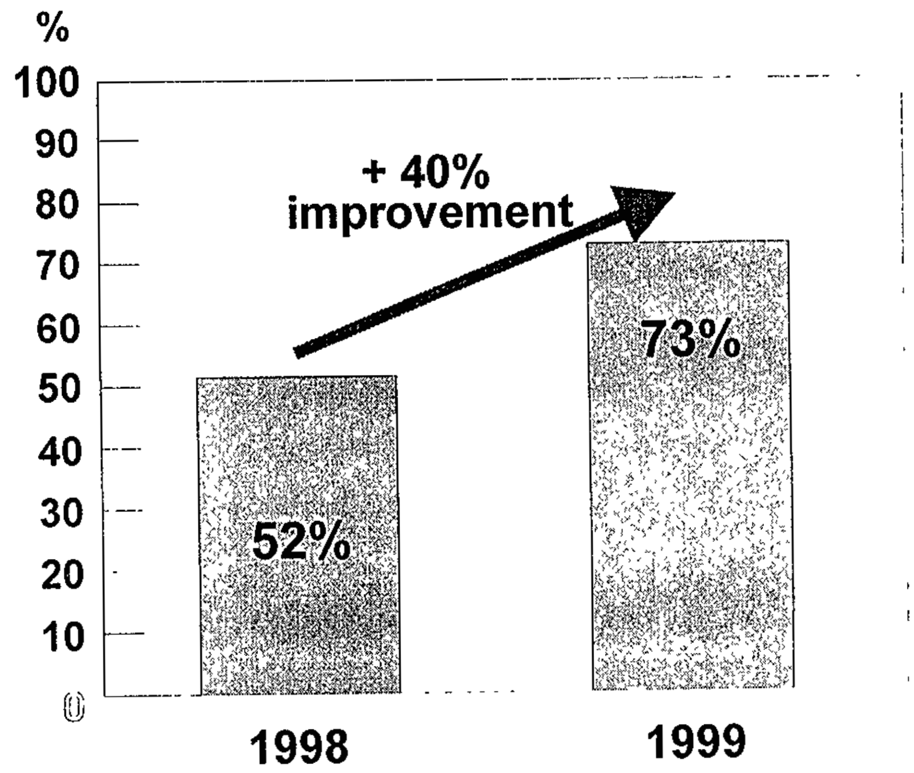
Safety Results



What Do Employees Think?

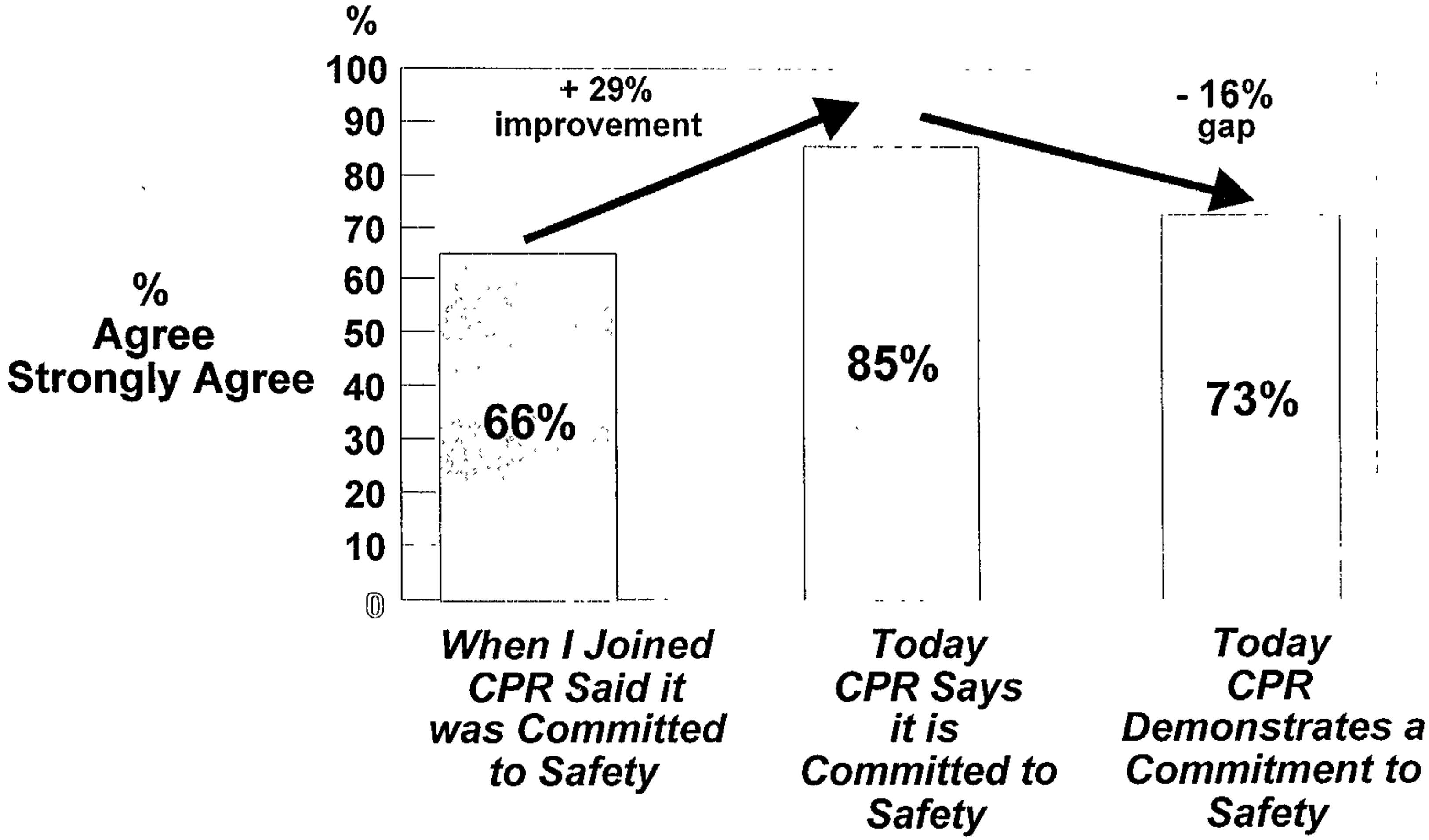
Employee Survey question
"CPR demonstrates a commitment to a safe work environment"

% Agree Strongly Agree



What Do Employees Think?

Employee Survey Questions



CANADIAN
PACIFIC
RAILWAY

International Rail Safety Conference

1999 BANFF

19 October - 22 October 1999
Banff Springs Hotel, Banff National Park, Alberta, Canada

Paper 9940

Robert H. Ritchie

Closing Remarks

Publisher
2000 International Rail Safety Conference

ROBERT J. RITCHIE,
PRESIDENT AND CHIEF EXECUTIVE OFFICER
CANADIAN PACIFIC RAILWAY

1999 INTERNATIONAL RAIL SAFETY CONFERENCE

BANFF, ALBERTA

OCTOBER 21, 1999

Ladies and Gentlemen,

I know that many of you have been hard at work at this conference for 2 days.

But it is my pleasure to formally welcome you here. And I'm especially pleased your organizers decided we'd meet here in the Canadian Rockies – one of Canadian Pacific Hotel's most outstanding facilities.

I love these mountains. I've hiked and skied them for years and hope you will have opportunities to do that, too. I've always been proud to know that the Canadian Pacific Railway opened this beautiful region to the world more than 100 years ago.

Sir William Van Horne is one of CPR's corporate heroes. He was a brilliant railway manager, credited with the rapid completion of the CPR in the 1880s and, as an amateur architect, he even helped plan this hotel. "If we can't export the scenery," he said, "we'll import the tourists."

I hope you glimpsed some of that scenery as you wound up the Bow River Valley on Tuesday, coming up from Calgary. And I hope you enjoyed the historical contrast between our vintage rail cars and the electronic and leading-edge operating equipment at our Intermodal Facility and Network Management Centre in Calgary.

This is the Tenth International Rail Safety Conference and let me congratulate the Japan East Railway for first suggesting these working conferences, with everybody engaged, bringing something to the table. It is unique, for it allows safety professionals from our railways to interact – to compare best practices – to learn and to enhance railway safety worldwide.

This tenth conference also marks some important firsts. We're proud to have you meeting in Canada for the first time. We're delighted to have representatives from the United States for the first time. And I'm very pleased to see representatives of Canadian trades unions actively participating for the first time.

I'm told there are regulators, accident investigators and rail company representatives from twelve countries here. And I understand that when you finish tomorrow, you'll have heard 30 papers and 50 presenters.

Sadly, we've all been very aware of the absence of two of our British colleagues, Vic Coleman and Mel Walter, preoccupied, of course, with the tragedy at Paddington Station, a fortnight ago.

We all have been personally impacted by the disaster scenes from London. Professionally, I know that rail passenger travel is far safer than highway travel and equivalent to air safety. We know the statistics. But Paddington will cause all of us to once again look at not only our own operating practices, but into our very heart and soul.

We know there will be a most rigorous review of British rail safety practices and, we know the outcomes will influence us all, world-wide, for we are all part of a public trust. And, I'm equally certain this organization will play an important role in disseminating recommendations developed by our British colleagues.

Ours is a 24 hours a day business, seven days a week, all year around. How do we manage operator fatigue? For my money, Australia is away ahead of the pack in supplying answers. Thank you, Australia. We're listening, carefully.

People are people and can have lapses of attention. They can make errors. That's universal. And experience tells us that this factor leads to incidents. Computers may be carefully calibrated. But how do we build in checks and balances on the people side? How could NASA people have mixed up metric and Imperial measurements and lost a mission to Mars?

How do we improve worker skills and knowledge levels? The best answer I know is to include the unions in solving these people problems. In Canada, I'm proud to be partnering on these issues with unions such as the UTU, the BLE and BMWE. Listen to what they have to say.

It isn't enough for us to know that our railways are far and away the safest means of ground transportation.

Or that railway jobs are safer than those in other heavy industries in North America.

Or that the number of main line derailments has been cut in half since 1984. It isn't enough to know that there are now 300 times more commercial vehicle accidents per ton-kilometre on Canadian highways, compared with each single rail accident.

We have to improve and, with our unions' active support, Canada's railways are investing more than $75 million a year on some 150,000 hours of safety-related employee training.

Also, similar to what takes place in other jurisdictions, Canadian railway companies and their employees invest countless hours in a highly successful public information and education campaign, called Operation Lifesaver, aimed at reducing the number of crossing and trespassing accidents. None of us can rest until we're certain all our workers -- and our customers – and the general public can always go home in safety.

The safety of workers on the tracks, for example, is a universal concern and I'm glad you're giving this the attention it deserves. Particularly given that today we must do more with less! But experience shows productivity and safety are not incompatible.

Also, ours is a 24 hour a day business, seven days a week, all year-round. So how we manage operator fatigue is also an issue. I understand that Australia is way ahead of the pack in supplying answers. Thank you, Australia. We're listening, carefully – and learning.

People are people and can have lapses of attention. They can make errors. That's universal. And experience tells us that this factor leads to incidents. Computers may be carefully calibrated. But how do we build in checks and balances on the people side? This was brought home to us when NASA mixed up metric and imperial measurements and lost a mission to Mars!

How do we improve worker skills and knowledge levels? The best answer I know is to include the unions in solving these people problems. At CPR, we are proud to be partnering on these issues with unions such as the UTU, the BLE and BMWE. We need to listen to what they have to say.

And finally, if Canada can bring something fresh to the table, it's perhaps the work we've done in developing our federal Railway Safety Act over the last decade.

For many years, the safety of Canada's federal railways was regulated under the Railway Act. This act was designed for the turn of this century when Canada's railway system was rapidly expanding.

At that time, much of the system was under construction to open up new territory and to encourage settlement. Small companies, without adequate financial reserves, built railway lines with uncertain revenue prospects.

There was a strong temptation to cut corners on construction and operating costs, and legislation was needed to allow the government of the day to closely control these activities, for the protection of the public and railway employees.

Unfortunately, we lived with that regulatory system for most of this century – long past the appropriate time.

Then, in 1989, our Railway Safety Act came into force. It tried to address the many changes that had taken place in the Canadian rail transportation industry over the decades. It was a great improvement but we weren't finished with reforms.

With the introduction of the Canada Transportation Act in 1996, the railway industry began to accelerate its restructuring process. In focusing more on their core railway infrastructure, national carriers transferred thousands of kilometres of track to short line operators.

Many of these transferred rail lines now fall under the jurisdiction of the provinces in which they exclusively operate. In some provinces, safety monitoring over these provincial railways is being done under contract as a result of federal-provincial agreements.

In 1999 there were further amendments to the Railway Safety Act, to further enhance the legislation and to make the railway system even safer.

These amendments are designed to fully modernize the legislative and regulatory framework of Canada's rail transportation system. They make railways even more responsible for managing their operations safely. At the same time, the general public and interested parties have a greater say on issues of rail safety. All stakeholders now have a clear voice in rail safety.

With these overhauls of rail transportation legislation, different legislation now exists for the three distinct purposes.

We have the Railway Safety Act, in which Transport Canada plays the lead role in overseeing safety in the industry and where the thrust is to simplify, update and improve safety regulation.

We have legislation for the Transportation Safety Board, an independent accident investigation agency for all federally regulated modes.

And we have the Canadian Transportation Agency, to provide the industry with greater freedom to act in the area of economic regulation.

The objectives, in amendment after amendment, quite simply are to "ensure the safe operation of railways."

Under this new federal legislation, the regulator focuses more on outcomes and less on process. The legislative body will not tell us how to operate safely – if we meet our obligation to do so.

Federal transport authorities, one could say, are passing some of their responsibilities on to the railways. We aren't complaining. It means more work but it also means more direct input on the safety rules governing our operations. In short, it means that we are a safer industry.

Our new Act streamlines the administrative process, broadens the consultation with labor and clarifies the powers of railway inspectors.

The most important new concept introduced is putting an obligation on railways to develop and implement a Safety Management System or SMS.

This means developing a formal framework for integrating safety into day-to-day railway operations. Safety becomes an integrally managed issue.

A company's SMS must include safety goals and performance targets, risk assessments, responsibilities and authorities, rules and procedures and monitoring and evaluation processes.

What's really significant is that when federal regulators approve a company's SMS, then the SMS can replace the rules or regulations currently under the act.

There must be checks and balances, of course. But the fundamental principles on which the regulation of railway safety in Canada is based are sound.

There are just four of these principles. They can be summarized as:

1. promoting and providing for the safety of the public and personnel, and the protection of property and environment,
2. encouraging the collaboration and participation of interested parties in improving railway safety;
3. recognizing the responsibility of railway companies in ensuring the safety of their operations; and
4. facilitating a modern, flexible and efficient regulatory scheme that will ensure the continuing enhancement of railway safety.

Given the results in other industries, we are certain that our Safety Management Systems will promote a stronger safety culture within

Canadian railways. We are confident we can demonstrate to workers, shareholders, and Canadians that we meet and often exceed all regulatory requirements.

But we're also mindful of the pitfalls, and that's the concluding image I want to leave with you.

I think it was a British professor, James Reason, who studied corporate culture and who thought of the Swiss cheese analogy.

Imagine blocks of Emmenthal Swiss cheese, the kind with irregular holes in them, stacked side by side. Most of the time, nothing can get through the holes, and go all the way from one side to the other. Just like our safety plans.

But once in a long while, there are just enough holes in our plans, lined up in just such a way as to enable a human mistake to get through. And, remember, 75 to 80 percent of accidents happen when someone makes a mistake.

Our job is to work out how can we stack our safety plans so that even a moment of human inattention, can't get through?

That's the challenge before every one of us every day. And that's the challenge before this conference.

I know you are addressing it as conscientiously as humanly possible. And I'm sure that's the spirit you will be taking home with you.

Ladies and Gentlemen, we are gathered in some of the most spectacular mountain scenery in the world.

I hope your time and the weather give you an opportunity to enjoy it -- and if not, please come back soon.