International Rail Safety Conference

1997 LUCERNE

21 May - 23 May 1997
Swiss Transport Museum, Lucerne, Switzerland

Paper 9700

Index of 1997 Conference Papers

Publisher
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9711	Jos. Hendriks	Learning from Incidents: Control the Controllable
9712	Satoshi Nakai	Crisis Management in the EJRC-Taking the example of a major earthquake
9713	Jean-Beranard Benech	Safety Arrangements for crossing rail tracks
9714	Stanley Robertson	Vandalism-Management of a Social Problem
9715	Paul Godier	Case Study-Suicides on London Underground
9716	Johan de Villiers	The principles of safe movement on rail (POSMOR) and Safety Management for the Future
9717	Dr Ch. Lienert	Risk Scenery at Swiss Railways
9718	Tomas Persson	Banverket-Experiences of decentralised maintenance machine ownership
9719	Tetsuro Aikawa	Cost-Effective Measures against Signal Overrun Accidents
9720	Don Davies	Tranz Rails's Alertness Management Programme
9721	Jan Stuifmeel	Case Study-Safety Philosophy New Freight Line
9722	Herman Bruwer	The social impact of the Transportation of Dangerous Goods by Railway
9723	Dieter Metz	Human Factor Strategies for Preventing the Causes

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Paper No.	Author	Remarks
9724	H.R. Lehmann	Safety Management and ISO-Certification
9725	Ben Keen Graham Arkwright	Risk based Safety Management
9726	Wong Woh Sung	Escalator Injuries in Railways
9727	Mrs Daphne Mabale	Risk Management-Involving Trade Unions in SHE (Safety, Health, Environment) Principles of a SHE Forum
9728	Bill Casley	Rail Safety Regulation Down Under
9729	Ulf Palsson	Harmonisation of Traffic Safety Rules in Scandinavia - Possibilities And Difficulties

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P. A. Urech

Welcoming Address

Publisher
2000 International Rail Safety Conference

Schweizerische Bundesbahnen
Chemins de fer fédéraux suisses
Ferrovie federali svizzere
Swiss Federal Railways

Generaldirektion
Direction générale
Direzione generale
Management Board

SBB CFF FFS

International Railway Safety Conference

21 - 23 May 1997
Lucerne

Welcome address

Dear delegates,
dear participants,

With great pleasure I welcome you to the 8th International Railway Safety Conference, in the heart of Switzerland. The opportunity of the 150 th birthday of Swiss Railways presents a special reference to safety issues: without the safety awareness of railwaymen/-women and the classical fail-safe approach in railway signalling and operations, such a jubilee could not be celebrated.

Although railways are ranged among the safest modes of transport, the challenge to held and improve permanently the safety level will keep up, because of deregulation of the railway industry, increased pressure for cost/effectivness of safety measures, change of organizations and complexer system mechanisms.

Therefore, the conference provides a unique platform to exchange the "state of the art" or "best practise" in all main features like management and trade-union committment, risk identification and assessment, incident and accident investigation and integrated safety-management apporach.

I thank you very much for your precious and valuables contributions to share lessons crosssing borders of companies, countries and continents. All Railways need it to improve their competitivness!

Please, receive my best wishes for enriching dabates and an excellent journey in Switzerland.

P.-A. Urech
General Director Infrastructure

International Rail Safety Conference

1997 LUCERNE

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Swiss Transport Museum, Lucerne, Switzerland

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List of Delegates

Publisher
2000 International Rail Safety Conference

Einplanung der Referate

Name, Funktion Unternehmung	Referats-Gruppe Referats-Titel	Datum	Session	Zeit
Mr.Willy Kaeslin Head of Contr.&Services Central Reg. Swiss Federal Railways	Safety at Work A new Approach in safety Management	21.05.95	I	0850-0920
Mr. Stanley Robertson Chief Inspector of Railways Health and Safety Executive	Work on the Track	21.05.95	I	0920-0950
Mr. Olle Mornell Senior Safety Administrator Swedish National Rail Administration	Human Factor Reducing Human Errors at Level Crossings in Sweden	21.05.95	I	0950-1020
Mr. Gérald Churchill Executive Manager RATP	Human Factor Human Reliability in the Safety-related Jobs at RATP	21.05 95	II	1040-1110
Mr. Yuzuki / Takahashi President of JREU East Japan Railway Workers' Union	Safety Management Union's Challenge to Safety for these 10 Years	21 05.95	II	1110-1140
Mr. Yajima/ Sekine Chairman Supervisor's Section East Japan Railway Workers' Union	Safety Management Takling Safety Measures in my Workplace	21.05.95	II	1140-1210
Mr. Olivier Cremien Psychologist SNCF	Human Factor Consideration of Traumatic Factors and their Treatment in jobs involving Safety-rel.	21.05.95	III	1400-1430
Mr. Jos Hendriks Staffmember Railway Safety Railned BV	Human Factor Learning from Incidents: control the controllable	21.05 95	III	1430-1500
Mr. Satoshi Nakai Manager East Japan Railway Company	Security and Safety Training Crisis Management in the EJRC; Taking the Example of a Major Earthquake	21 05 95	III	1500-1530
Mr. Jean-Bernard Bénech Head of Safety Studies Center SNCF	Human Factor Safety Arrangements for crossing Rail Tracks	21.05.95	IV	1600-1630

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Einplanung der Referate

Name, Funktion **Unternehmung**	**Referats-Gruppe** **Referats-Titel**	**Datum**	**Session**	**Zeit**
Mr. Hansrudolf Lehmann Quality Manager Rolling Stock Div. Swiss Federal Railways	Safety Management Safety Management an ISO-Certification	22.05.97	VII	1500-1530
Mr. Keen / Arkwright Safety Policy Adviser Railtrack plc	Safety Management Risk based Safety Management	22.05 97	VIII	1600-1630
Mr. Mike Siebert Controller Safety Assurance Railtrack plc	Safety Management Risk based Safety Management	22.05.97	VIII	1630-1700
Mr. Wong Woh Sung Manager Safety Services Singapore MRT Ltd.	Safety Management Escalator Injuries in Railways	22.05.97	VIII	1700-1730
Mrs. Daphne Mabale Occupational Risk Consultant Spoornet SA	Risk Management Involving Trade Unions in SHE (Safety; Health; Environment), Principles of a SHE F	23.05 97	IX	0900-0930
Mr Ulf Pålsson Joint Director Swedish State Railway	Safety Regulations Harmonisation of Traffic Safety Rules in Scandinavia; possibilities and difficulties	23.05.97	IX	0930-1000
Mr. Bill Casley Executive Dir. Transp Safety Bureau New South Wales Dept. of Transp.	Safety Regulations Rail Safety Regulation Down Under, An Overview of Recent Achievments	23 05.97	IX	1000-1030

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International Rail Safety Conference

1997 LUCERNE

21 May - 23 May 1997
Swiss Transport Museum, Lucerne, Switzerland

Paper 9703

Conference Programme

Publisher
2000 International Rail Safety Conference

INTERNATIONAL RAILWAY SAFETY CONFERENCE 1997 AT LUCERNE

Wednesday 21 May - Friday 23 May 1997

Conference-Programme

TIME	FUNCTION	Direction	SUBJECT	WHERE
20 May 97 16 00 - 19 00	Registration, handing out of documentation Programme voucher for consorts			Swiss Transport Museum, entry to conference room
19 00 - 21 00	Welcome drink for those delgates and consorts, who have already arrived	H P Hadorn		Swiss Transport Museum, restaurant "Cockpit"
21 May 97 07 30 - 08 30	Registration, handing out of documentation Programme voucher for consorts			Swiss Transport Museum, entry to conference room
08 30 - 08 50	Opening of the conference Welcome address to the delegates	H P Hadorn		Conference room
08 50 - 10 20	Session I 0850 - 0920 Mr W Kaeslin 0920 - 0950 Mr Stanley Robertson 0950 - 1020 Mr Olle Mornell	E Widmer	Safety at work Work on Track Human Factor	Conference room
10 20 - 10 40	Coffee/tea break			In a exhibition hall or in the open, depending on weather
10 40 - 12 10	Session II 1040 - 1110 Mr Gérald Churchill 1110 - 1140 Mr Yuzuki and Mr Takahashi 1140 - 1210 Mr Yajima and Mr Sekine	E Widmer	Human Factor Prevention of accidents Safety measure in workplace	Conference room

INTERNATIONAL RAILWAY SAFETY CONFERENCE 1997 AT LUCERNE

Wednesday 21 May - Friday 23 May 1997

Conference-Programme

TIME	FUNCTION	Direction	SUBJECT	WHERE
21 May 97 12 10 - 14 00	Lunch			Swiss Transport Museum, restaurant "Cockpit"
14 00 - 15 30	Session III 1400 - 1430 Mr Olivier Cremien 1430 - 1500 Mr Jos Hendriks 1500 - 1530 Mr Satoshi Nakai	O Stalder	Traumatic factors and their treatment Human Factor Security and Safety Training	Conference room
15 30 - 16 00	Coffee/tea break			In a exhibition hall or in the open, depending on weather
16 00 - 17 30	Session IV 1600 - 1630 Mr Jean-Bernard Bénech 1630 - 1700 Mr Stanley Robertson 1700 - 1730 Mr Paul Godier	O Stalder	Passengers safety Vandalism Suicides on the railway	Conference room
22 May 97 09 00 -10 30	Session V 0830 - 0900 Mr Johan de Villiers 0900 - 0930 Mr Christoph Lienert 0930 - 1000 Mr Tomas Persson	W Kaeslin	Safety Management Risk Management Equipment and Engineering	Conference room
10 00 - 11 00	Coffee/tea break			In a exhibition hall or in the open, depending on weather
11 00 - 12 30	Session VI 1100 - 1130 Mr Tetsuro Aikawa 1130 - 1200 Mr Don Davis 1200 - 1230 Mr Jan Stuifmeel	W Kaeslin	Equipment and Engineering Humn Factor/Safety Mgt Case Study	Conference room

INTERNATIONAL RAILWAY SAFETY CONFERENCE 1997 AT LUCERNE

Wednesday 21 May - Friday 23 May 1997

Conference-Programme

TIME	FUNCTION	Direction	SUBJECT	WHERE
22 May 97 12 30 - 14 00	Lunch			Swiss Transport Museum, restaurant "Cockpit"
14 00 - 15 30	Session VII 1400 - 1430 Mr Herman Bruwer 1430 - 1500 Mr Dieter Reuter 1500 - 1530 Mr Hansrudolf Lehmann	H P Hadorn	Risk Management Human Factor Safety Management	Conference room
15 30 - 16 00	Coffee/tea break			In a exhibition hall or in the open, depending on weather
16 00 - 17 30	Session VIII 1600 - 1700 Mr Ben Keen and Mr Graham Arkwright 1700 - 1730 Mr Wong Woh Sung	H P Hadorn	Safety Management Safety Management	Conference room
19 15 - 22 30	Gala-Dinner for delegates and consorts	Dick/Hadorn		Steamboat "Schiller", departure at 18 45 at pier no 5 (near main station)
23 May 97 09 00 - 10 30	Session IX 0900 - 0930 Mrs Daphne Mabale 0930 - 1000 Mr Ulf Pålsson 1000 - 1030 Mr Bill Casley	Ch Lienert	Risk Management Safety Regulations Safety Regulations	Conference room
10 30 - 11 00	Coffee/tea break			In a exhibition hall or in the open, depending on weather
11 00 - 11 30	Closing session	H P Hadorn		Conference room

Einplanung der Referate

Name, Funktion Unternehmung	Referats-Gruppe Referats-Titel	Datum	Session	Zeit
Mr Stanley Robertson Chief Inspector of Railways Health and Safety Executive	Vandalism Management of a social problem	21.05 95	IV	1630-1700
Mr Paul Godier Head of Safety and Env Developt London Transport	Case Study Suicides on the Railway	21 05 95	IV	1700-1730
Mr. Johan de Villiers Senior Manager Spoornet SA	Safety Managment The Principles of safe Movement on Rail (POSMOR) and Safety Mgt for the Future	22.05 97	V	0830-0900
Mr Dr. Christof Lienert Risk Manager Swiss Federal Railways	Risk Management	22.05 97	V	0900-0930
Mr. Tomas Persson Senior Heavy Rail Vehicle Adm. Swedish National Rail Administration	Equipment and Engineering Banverket - Experiences of decentralised Maintenance Machine Ownership	22.05 97	V	0930-1000
Mr. Tetsuro Aikawa Vice Director East Japan Railway Company	Equipment and Engineering Cost-effective Measures against Signal Overrun Accident	22.05 97	VI	1100-1130
Mr Don Davis Corporate Manager Quality + Safety Tranz Rail Ltd.	Human Factor/Safety Management Alertness Management Training	22 05 97	VI	1130-1200
Mr. Jan Stuifmeel Staffmember Railway Safety Railned BV	Case Study	22 05 97	VI	1200-1230
Mr Herman Bruwer Manager Risk Managment Spoornet SA	Risk Management The Social Impact of the Transportation of dangerous goods by Railway	22 05.97	VII	1400-1430
Mr Dieter Reuter Safety Manager Deutsche Bahn AG	Human Factor Strategies for preventing the causes /Video: Markus and the language of signals	22 05 97	VII	1430-1500

INTERNATIONAL RAILWAY SAFETY CONFERENCE 1997 AT LUCERNE

Wednesday 21 May - Friday 23 May 1997

Conference-Programme

TIME	FUNCTION	Direction	SUBJECT	WHERE
23 may 97	Optional excursion for delegates and consorts, within and together with a jubilee function 150 years of Swiss Railways			
12 00 - 17 30	**Excursion to the Rigi** Departure: 12 13 at Verkehrshaus-Lido (boat) 13 23 Rigi-Staffelhöhe Lunch at restaurant "Edelweiss" Return. 17 27 at Lucerne	W Kaeslin		
12 00 - 16 30	**Excursion to the BLZ Luzern** Lunch at Swiss Transport Museum Departure: 13 30 to the BLZ Luzern Return: 16 30 railwaystation Lucerne	H P Hadorn		

INTERNATIONAL RAILWAY SAFETY CONFERENCE 1997 AT LUCERNE

Wednesday 21 May - Friday 23 May 1997

Final programme for escorts

TIME	FUNCTION	WHERE	WHO
We 21 May 14 00 - 17 00	Guided city-sightseeing: "- walk - Picasso museum - Town hall - - Coffee/tea break in the Hotel des Balances	14 00 Schwanenplatz (Bucherer)	Tourist Office Lucerne
Thu 22 May 10 00 - 14 45	Visit to the glass manufacture at Hergiswil: - Bus transfer to Hergiswil - Inspection of glass works, shopping - Lunch in Hotel Belvedere at Hergiswil - Return trip by boat	10 00 Schwanenplatz (Bucherer)	Tourist Office Lucerne
Fr 23 May	We recomend a shopping outing in the city and/or a visit to the Transport Museum and the IMAX-cinema	Entry tickets to the Transport Museum are offered free of charge in the conference office. Entry to the IMAX cinema is payable	
	Further tips and propositions are available from the city's tourist office, or from the information desk at the railway station		

INTERNATIONAL RAILWAY SAFETY CONFERENCE 1997 AT LUCERNE

Wednesday 21 May - Friday 23 May 1997

Final programme: Post-conference Excursion

TIME	FUNCTION	WHERE	WHO
Sa 24 May 08 00 - 18 00	Excursion to the Jungfraujoch - Top of Europe - Luch in the restaurant "Top of Europe" - Return trip by trains and bus to Lucerne Other excursion possibilities can be arranged for you at the Tourist Office of the City of Lucerne, or in the railway station of Lucerne	Departure at 08 00 from Schwanenplatz (Bucherer)	Tourist Office Lucerne

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Paper 9704

Willy Kaeslin

Safety at Work: A new approach in Safety Management

Publisher
2000 International Rail Safety Conference

Schweizerische Bundesbahnen
Chemin de fer fédéraux suisses
Ferrovie federali svizzere
Swiss Federal Railways

INTERNATIONAL RAILWAY SAFETY CONFERENCE (IRSC) 1997
21 to 23 May, Lucerne / Switzerland

PAPER: ***Safety at Work***
A new Approach in Safety Management

PRESENTED BY: **Mr. W.Kaeslin**
Head of Controlling &Services Central Region

DATE: **21.05.97**

SESSION: **I**

TIME: **0850-0920**

International
Railway Safety
Congress
Lucerne/Switzerland
May 20 - 23, 1997

A NEW APPROACH IN SAFETY MANAGEMENT

presentation by
Willy Kaeslin
Manager Controlling and Services
SBB, Central Region

Ladies and Gentlemen
Dear Experts and Friends from all over the world

1. Welcome

Swiss Railroads are in operation since 1847; they deliver an excellent service for 150 years!
This anniversary is a unique chance to make everybody aware of the wide program of public transportation. Even though the Swiss are - behind the Japanese - the most active Railroad-users in the world there is a lot of work to be done to improve our image and service, to create more goodwill and to prove our potential as a springboard into the future of our country.
The Swiss Railroads - the SBB is part of it - are very active this year in organising special Railroad-oriented events and programs to attract old and new customers.

2. Prologue

Before I concentrate on my subject "A new Approach in Safety-Management" I would like to give some figures on the performance of the Swiss Railroad companies.
There are roughly 60 Railroad Companies in Switzerland using 5000 kilometres of track (Standard- and narrow-gage).
The SBB own 3000 kilometres of track and 800 stations. We handle 720'000 passengers per day in different categories of trains such as Eurocity-Trains, Intercity-Trains, Interregional Trains as well as local- and S-Bahn Trains. This represents 10% of our population.
The same network is handling 200'000 tons of freight per laborday, half/half in national/international traffic.
32'000 employees are responsible for a smooth efficient, on-time-operation day and night, 365 days per year.
Our trains run fully electric.

The average number of trains per day and line is 110 with a maximum of 450 trains per day.
We are a great little running Railroad with impressive figures; we get quite good scores from our customers,
. . . . with the exception of the field of Safety/Security!

3. Safety on the job

3.1 How it all began . . .

In 1994 we had a concentration of fatal and lethal accidents.
As a consequence our headquarters decided a new approach in order to turn around our safety/security-performance with the concentration on safety on the job.
It was evident to cooperate with the world-wide well accepted experts of Du-Pont/SEMS (Safety and Environmental Management Services). Following the analysis and the assessment of the existing situation concerning safety on the job there was the planing of the procedure.

The Swiss Federal Railways were fast learners and set their own demanding objectives:

- all accidents/injuries can be eliminated
- the health and physical as well psychical integrity of our employees has top priority
- Safety management is a top-down-affair and is everybody's business
- Safety is to be equally treated as other business parameters like productivity, finances, punctuality, etc.
- reduction of job-related accidents add to the availibility of human resources
- reduction of job-related accidents helps cut costs of productivity
- reduction of job-related accidents improve image as transportation company and as an employer.

3.2 Our means and programs to reach our objectives in 1995/96

Management Seminars

- Introduction into Safety-management
- Integration of Safety/Security-concerns into "daily" business and equal treatment

- Formation of Safety engineers (supervisors, experts) on all levels
- Formation of Safety organisations
- Running of some 100 management seminars led by experienced instructors of DuPont/SEMS.

2500 employees of the SBB got their excellent training starting from the top/director all the way to the foreman in the field.

The main subjects of the seminars are
- "Behavioural therapy": How to deal with Safety
- Promotion of the conviction that more than 90% of accidents are man-made
- Strengthen the sense of the employee's personal responsibility for himself as well as the people around and reporting to him
- Strengthen of "Vorbild" - setting the example
- Behaviour in Safety is part of personal qualification.
- The traininig is practical, repetitive and efficient as it is man- and less job-oriented.

Communication

- Creation of Corporate identity: Safety pin/Safety first
- Introduction of companywide monthly safety performance charts
- Introduction of train-, yard- and construction-service manual in Comic-Style (in 3 languages)
- Running of campaigns with one topic at a time: personal protective equipment/orange safety jacket, hard head, goggles, safety shoes, etc.
  We use wordless pictograms; this is an easy way to reach all our employees independent from their 20 languages!
- Publication of important knowledge and positive (and negative) performances.

4. The first "successes"

- All employees by now know:

- Safety is the primary concern and continuing responsibility of each supervisor <u>and</u> employee alike - Through such concern we protect each other, minimize accidents and emphasize the fact that our employees are our most important and precious asset. - Safety is part of the quality of the product - Safety-committees and Safety-experts are active through-out our company - Good Safety-management helps reduce costs.

Investments into Safety- and Securityprojects become easier to be financed. Safety and Security is "socially acceptable" and is part of basic training of employees.

Our results 1994-96:

- When we started with DuPont in middle 1994 we registered around 12 on-the-job-accidents per 100 employees per year. The off-the-job rate was 16. Today, 2 years later we can report:

- the accidents on the job went down 28%! - the days-off went down 29%! - we saved SFr 11 million in direct costs, not to mention indirect costs!

5. Targets for the near future

Per end of 1997 we want to reach:
- Reduction of accidents on the job down to 6 accidents per 100 employees per year; this equals 50% of the 1994-figure.
- Reduction of accidents off-the-job; summer campaign: hard head for bikers and skaters

- Continuous training of train-, yard and construction-men with support of Du-Ponts well-known STOP (Safety Training and Observation Programm)
- inprove Safety-management and establish our own internal training programs with the help of SBB-own crew of trainers/experts, moderators and coordinators commited to Safety.

The success as of today has motivated our top management to set aside the money and plan the time to push through this ambitious program.

6. Epilogue

Our business is transportation and we will stay in business as long as shippers and travellers can be assured arriving at destination safe, undamaged and on time.
Safety is vital for efficient transportation; we try harder to further improve our business.
We will involve all our employees so that they will understand our ultimate objective and will go for it.

Thank you for your attention.
Hafe a safe day!

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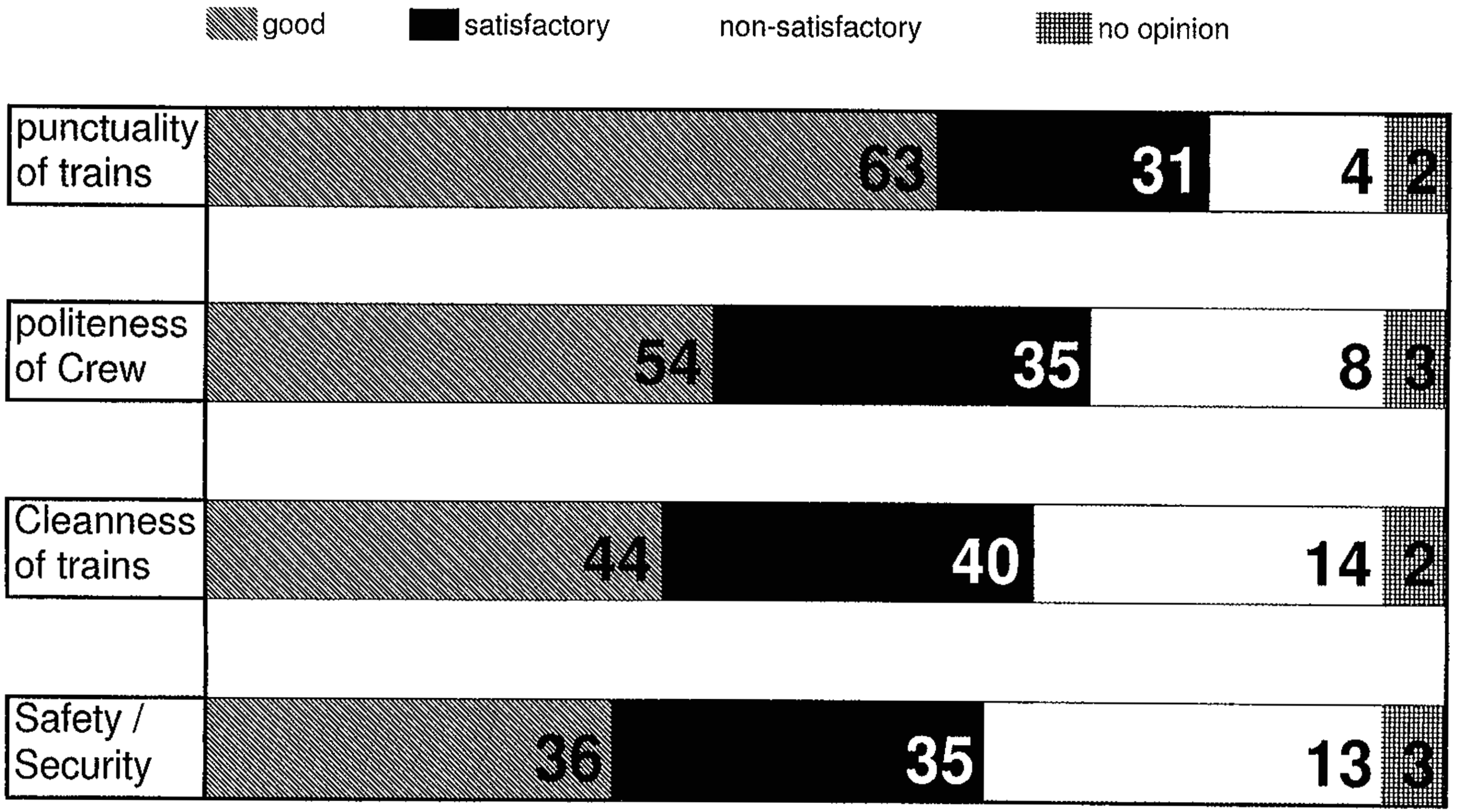
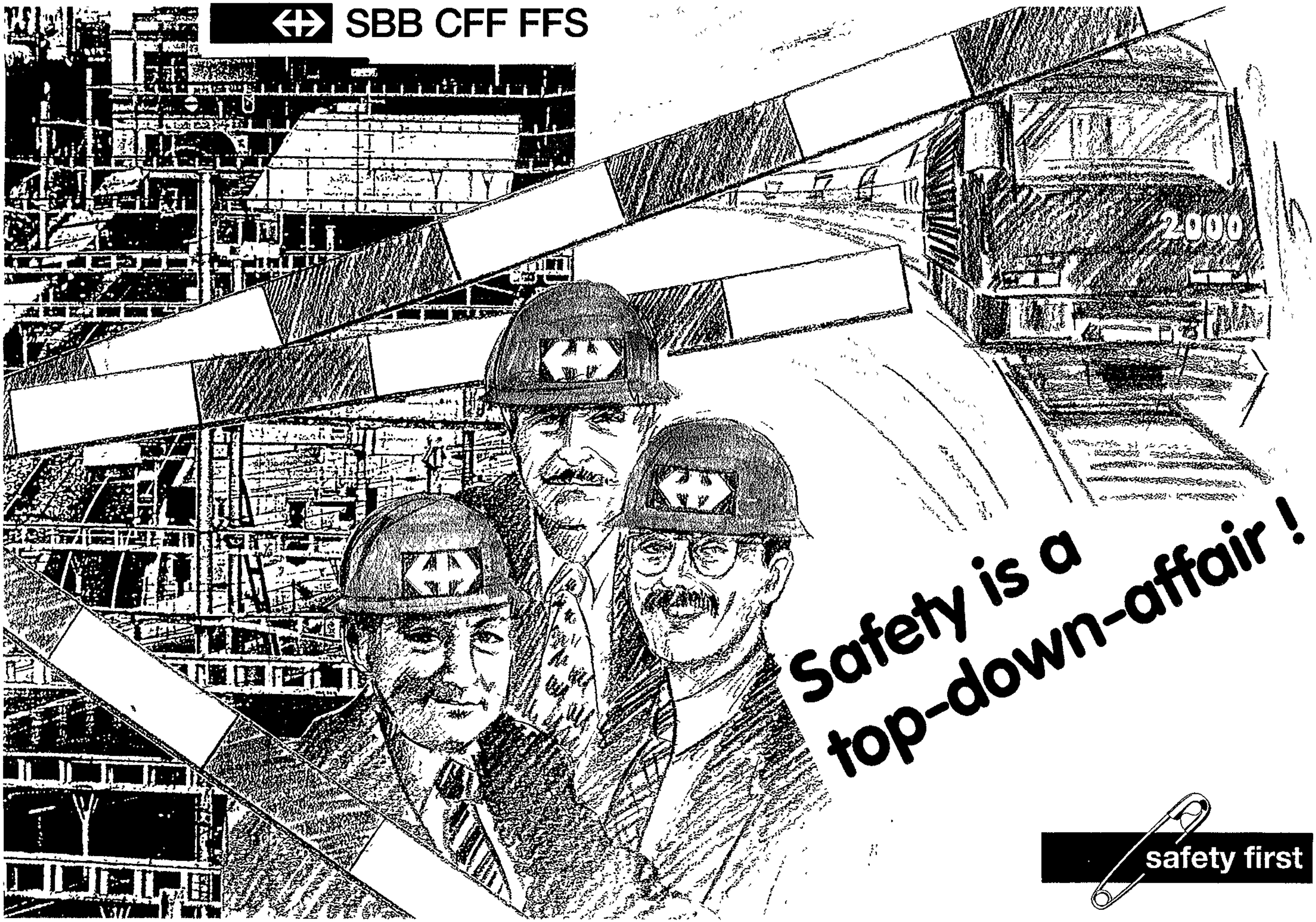
SBB: Judgement by customers

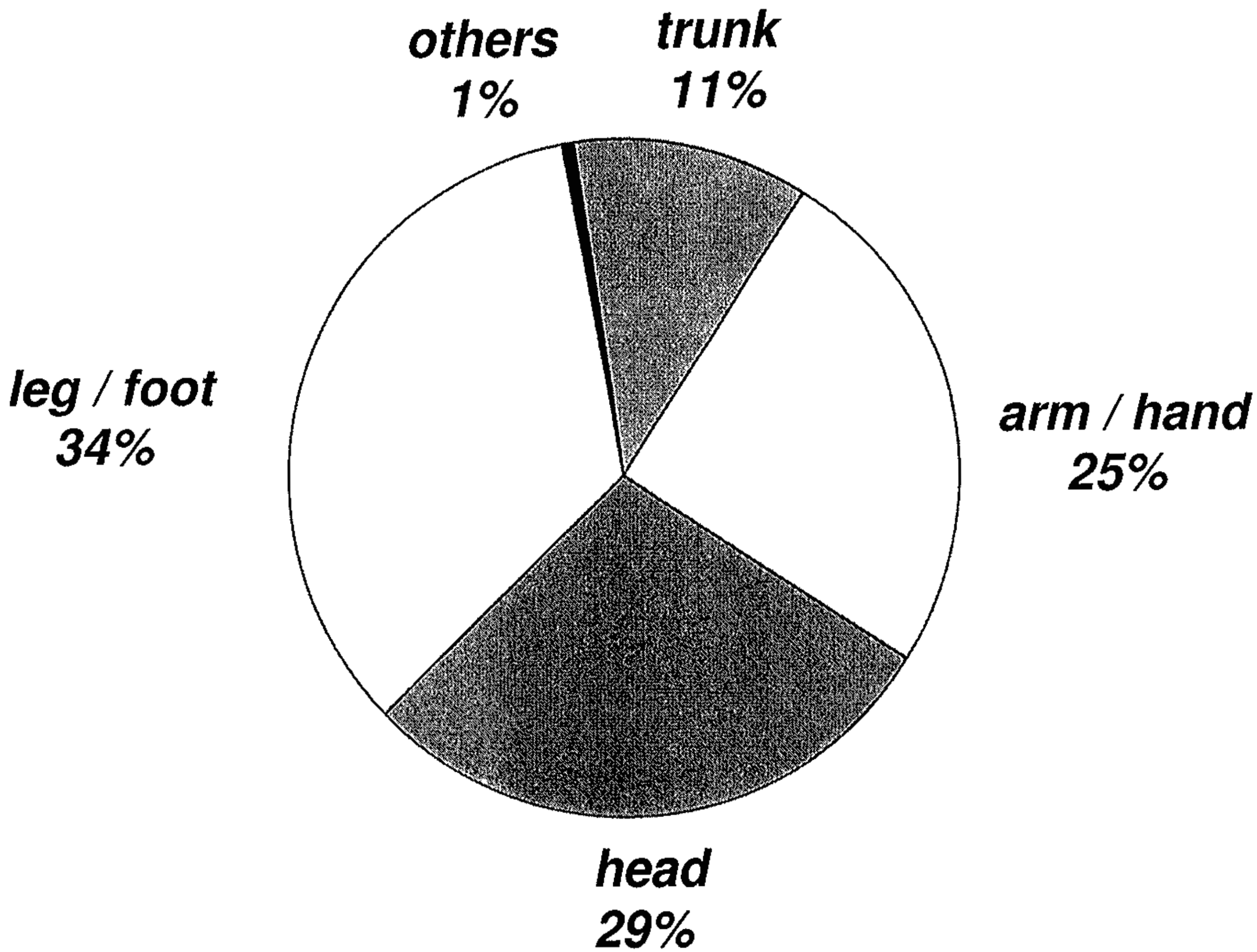


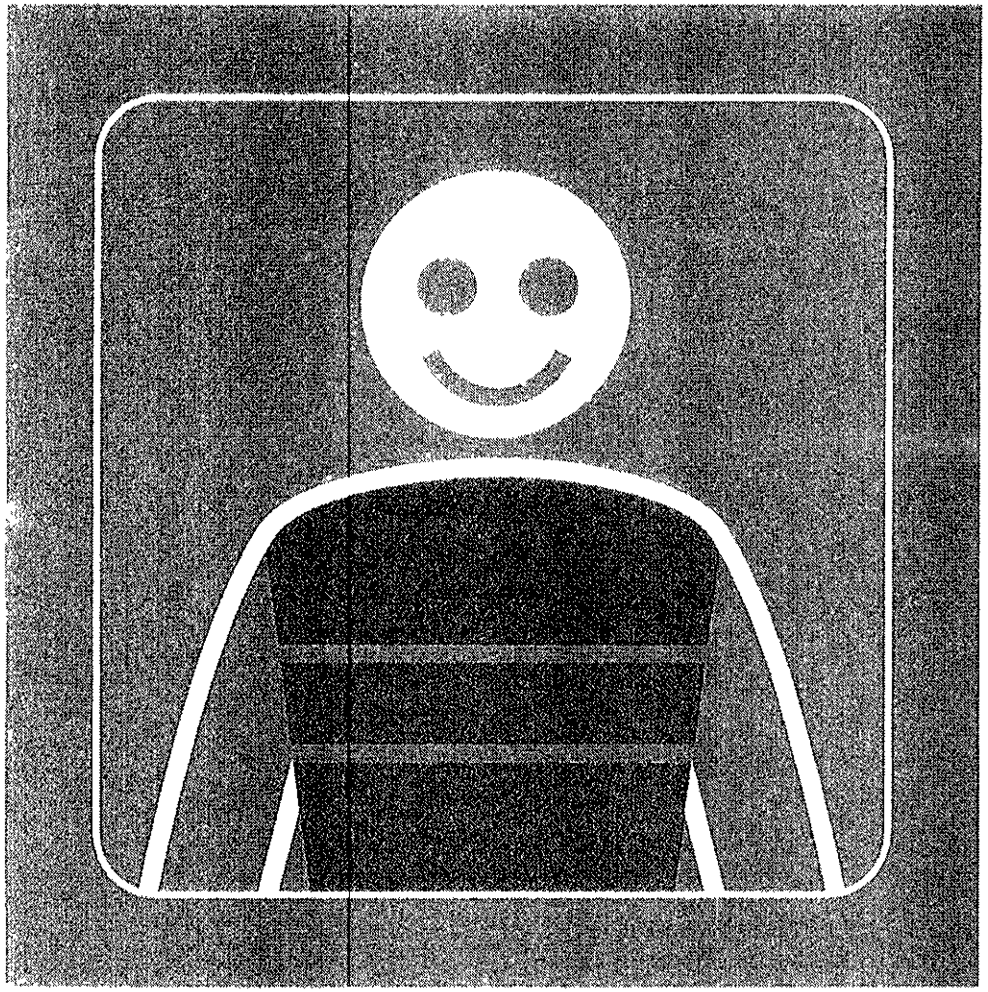

SBB CFF FFS
2000
Safety is a
top-down-affair !
safety first

safety first

SBB CFF FFS

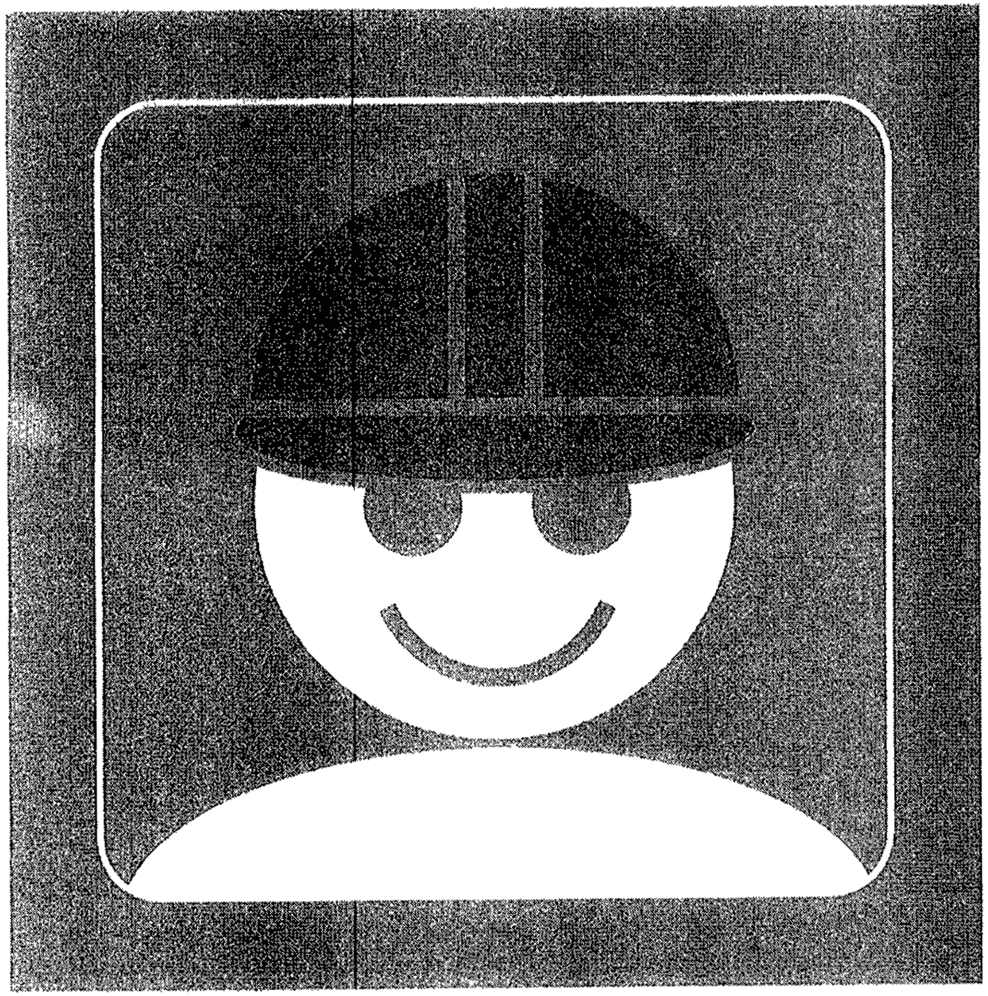
Accidents on the job; Groups of injuries 1996





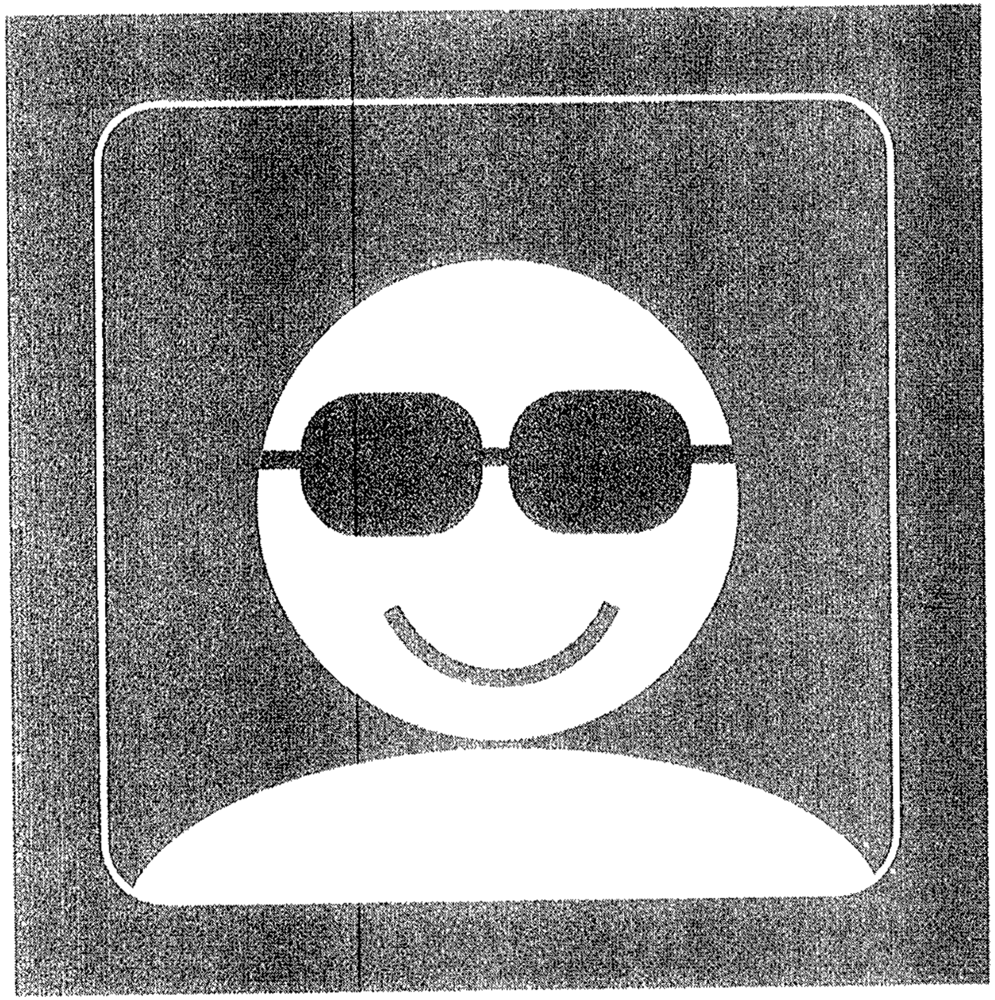
safety first

SBB CFF FFS



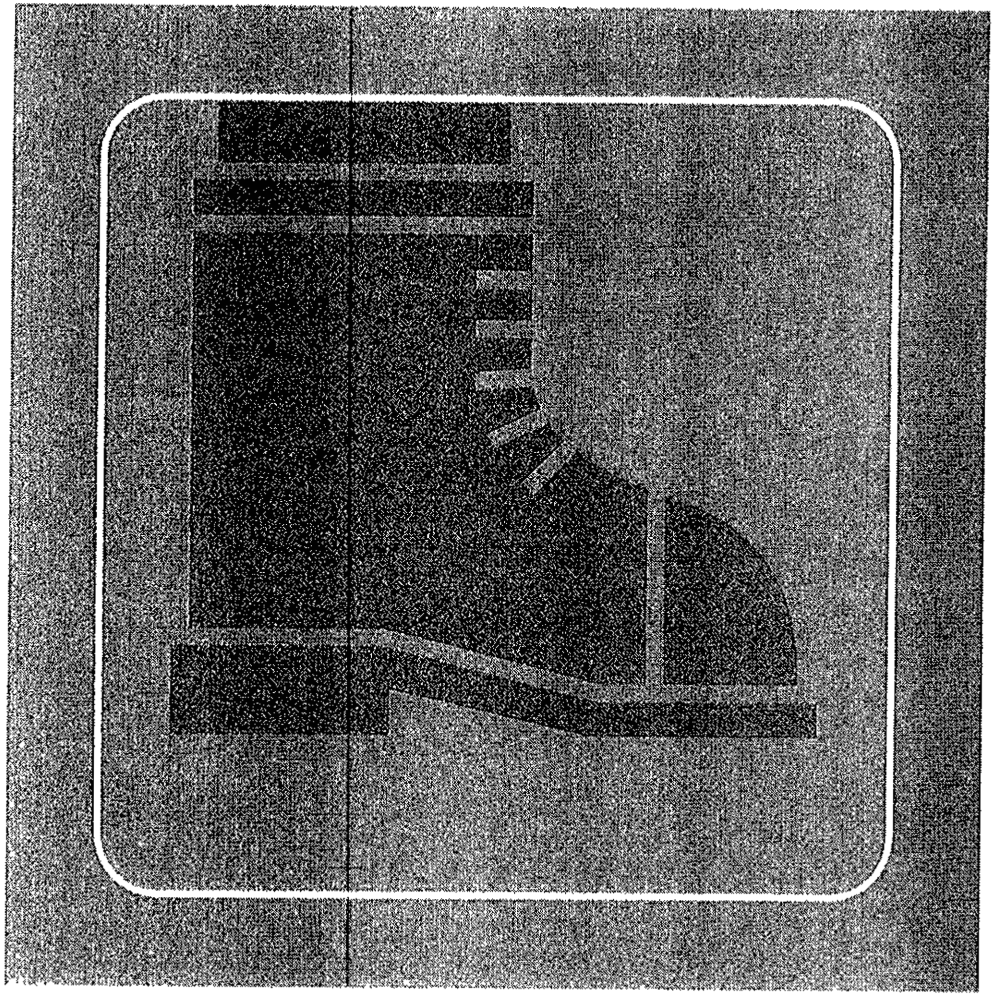
safety first

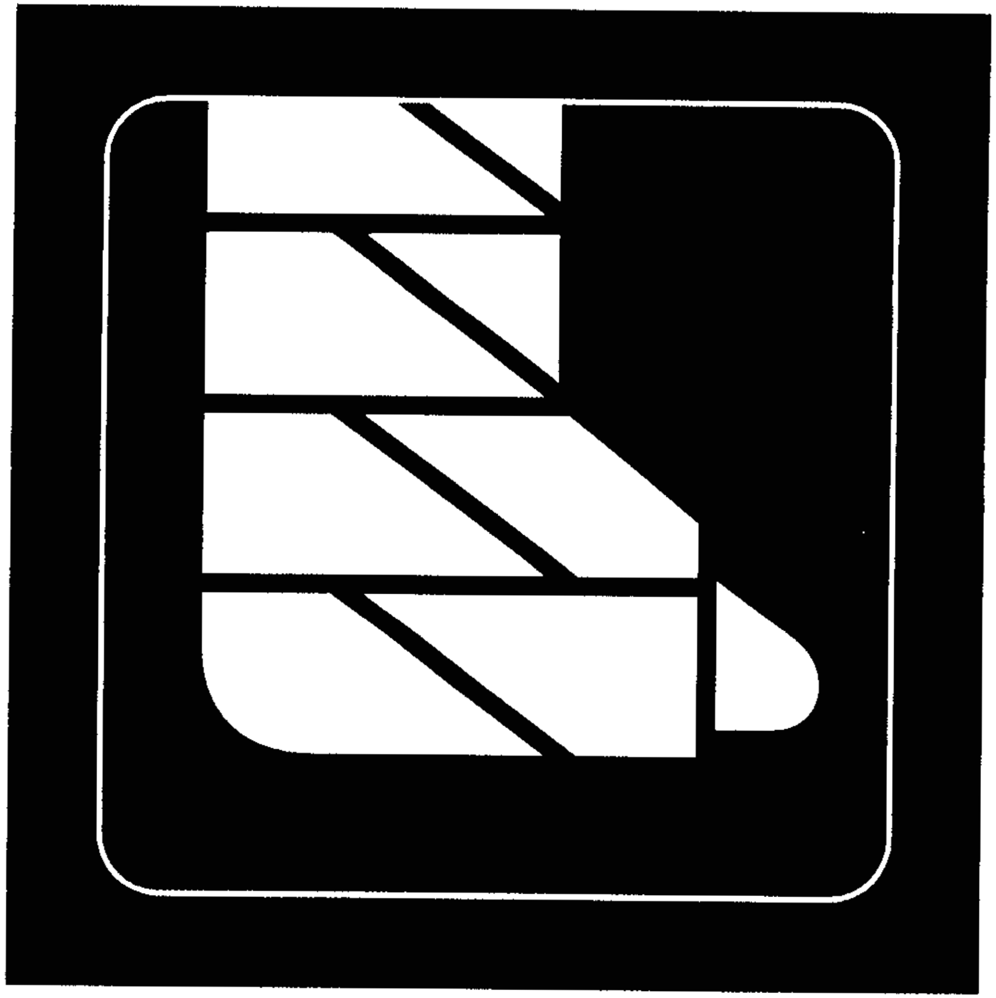
SBB CFF FFS



safety first

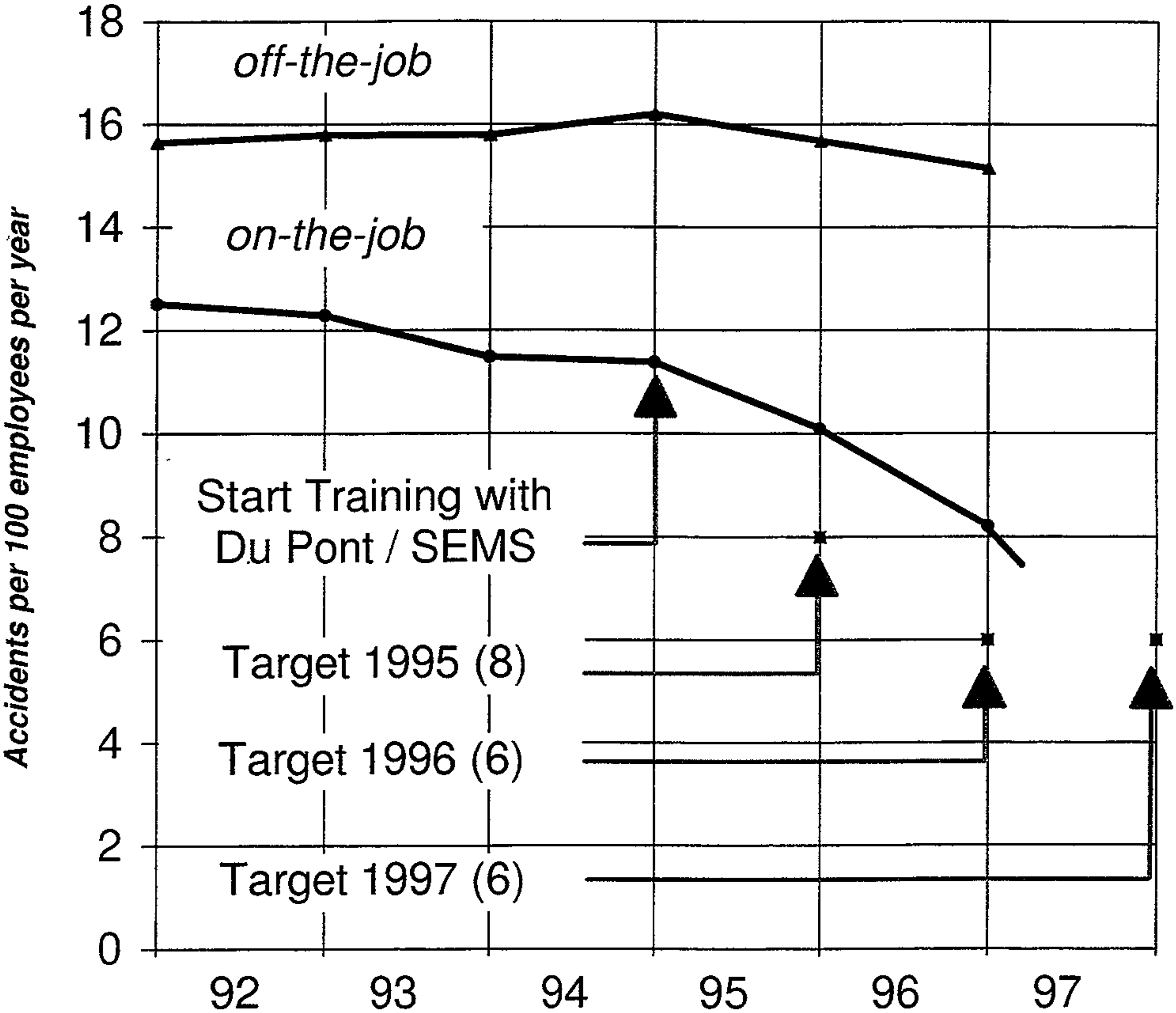
SBB CFF FFS





safety first
SBB CFF FFS

Development of accidents1991 - 1997



Development of accidents on the job 1994-1997

	Accidents per 100 empl./ year		Days off		Direct Costs SFr. 600.- per day	
	Rate	%	Days	%	SFr.	%
1994	11.4	100	63'420	100	38 mil	100
1995	10.1	89	55'430	87	33 mil	87
1996	8.2	72	44'824	71	27 mil	71
Succes	3.2	28	18'596	29	11 mil	29

Numbers of employees: 33'000

Source: SBB-BAD

safety first

Tell me and I forget
Show me and I remember
Involve me and I understand.

Konfuzius

International Rail Safety Conference

1997 LUCERNE

21 May - 23 May 1997
Swiss Transport Museum, Lucerne, Switzerland

Paper 9705

Stanley Robertson

Work on the Track

Publisher
2000 International Rail Safety Conference

Schweizerische Bundesbahnen
Chemin de fer fédéraux suisses
Ferrovie federali svizzere
Swiss Federal Railways

INTERNATIONAL RAILWAY SAFETY CONFERENCE (IRSC) 1997
21 to 23 May, Lucerne / Switzerland

PAPER: Work on the Track

PRESENTED BY: Mr. St. Robertson
Chief Inspector of Railways

DATE: 21.05.97

SESSION: I

TIME: 0920-0950

INTERNATIONAL RAILWAY SAFETY CONFERENCE: 21-23 MAY 1997

WORK ON TRACK - THE BRITISH EXPERIENCE

S S J Robertson, HM Chief Inspector of Railways, Health & Safety Executive, UK

THE STRUCTURE OF RAILWAYS IN GREAT BRITAIN

The rail industry in Great Britain has undergone a period of rapid and significant change Services which for more than 40 years had been provided by a single vertically integrated state-owned corporation, British Rail, are now being supplied jointly by more than one hundred units in the private sector

The most radical change in the new structure was the separation from 1 April 1994 of infrastructure provision and management from train operations. A new company, Railtrack, now privatised, owns and manages the vast majority of track, signalling and other operational infrastructure of Britain's railways Over thirty separate companies have been created to operate passenger and freight services, each of which must pay Railtrack for the use of track, signalling and traction current

Maintenance, renewal and modernisation of railway infrastructure is in the hands of newly privatised companies formed from British Rail's engineering arms, supplemented by several other private sector contractors Thus there are over 30 different companies regularly working on the track, many operating on-track plant and machines

HM RAILWAY INSPECTORATE

The Inspectorate was founded in 1840, following a suggestion by George Stephenson to inspect the burgeoning private railways of the time and to report to the government on their activities. Today the Inspectorate, as part of the Health and Safety Executive, continues the task of improving safety for passengers and workers alike, by inspecting new works, investigating accidents and analysing safety performance. The Inspectorate is responsible for the enforcement of health and safety legislation, and its inspectors have a wide range of powers, including issue of improvement and prohibition notices, and initiation of prosecutions for breaches of legislation.

The Railway Industry Advisory Committee (RIAC) was first established in 1978 to advise on matters relating to health and safety within the rail industry Members are nominated by employers and trades unions, and the Chairman is the Chief Inspector of Railways With railway privatisation, this Committee has taken a higher profile, and now includes representation of Railtrack, train companies and contractors in place of the previous British Rail membership

TRACK SAFETY : BACKGROUND

At the opening of the Liverpool and Manchester Railway in 1830, a local Member of Parliament, William Huskisson, was struck down by a locomotive, after he had left his train to walk across the track to speak to the Duke of Wellington. This early fatality is typical of the accidents that have occurred to thousands of railway workers since that date.

By the end of the last century, when the railways in Britain had made huge advances in safety measures for passengers, some high risks to railway workers were recognised in the Statutory Rules and Orders made in 1902 under powers of the Railway Employment (Prevention of Accidents) Act 1900. These Rules included the requirement that the railways provide men or apparatus to give warning of the approach of trains to gangs repairing or relaying the track

No other statutory duties applied to these risks until the Health and Safety at Work etc Act 1974, which requires employers to take measures to ensure the health and safety of their employees "so far as is reasonably practicable " This implies a form of risk assessment to ensure that the measures taken to remove a hazard or reduce the risk from it are in proportion to the level of that risk.

It quickly became apparent that there were reasonably practicable steps that needed to be adopted to reduce the high level of accidents then still applying to track workers. Indeed the fatal accident rate was comparable to that for workers in apparently more hazardous industries such as mining and construction

British Rail undertook a number of initiatives, including development of warning systems, improved safety management systems, and increased training and competency requirements.

TRACK SAFETY: PRINCIPLES

In order to improve further, in a structured manner, RIAC has produced a guidance document "Railway Safety: the prevention of risk to workers on the track"

This guidance is concerned with identifying measures which should be taken to protect those required to work on or near railway tracks Its aim is to lay down high level principles for application on any railway system.

The document lays down the fourteen principles, under five headings

A. Remove the Risk

Principle 1 So far as is reasonably practicable, work should be done when trains are not running at all.

Principle 2 Where work must be done during times when trains are running, so far as is reasonably practicable:-

a. trains should be diverted onto other tracks for the duration of the work,

b. the work site should be fenced of from any track remaining open to trains;

c. safe means of access to a separated site should be provided, separated if possible from any track in use.

Principle 3 Where it is not reasonably practicable to stop or divert trains, opportunities for access to the track should be provided between train movements where practicable. Methods of using those opportunities safely, by formal and recorded arrangements, supported by suitable protective measures, should be devised and installed

B. Work in Traffic: Protective Systems

Principle 4 Where it is not reasonably practicable to separate the work from running trains, people who need to work on or near the track will need to be protected by a system that gives adequate warning of the approach of trains

Principle 5

a People who need to go on or near the track when trains are running must be fit to do so.

b They must receive appropriate training, refreshed at suitable intervals, and comprehensive information to equip them to behave safely

c People with additional responsibility of others should receive additional training and carry a certificate of competency

Principle 6

a Safe means of access to the track should be provided and maintained.

b Where people may be on or near the track open to the passage of trains, places of safety should be provided and maintained.

Principle 7. Information from which safety on the track can be planned should be provided in a convenient and comprehensible form to everyone who needs it.

C. Safety Systems to Warn of Trains

Principle 8. Where reasonably practicable, automatic warning systems should be provided using technology of signalling-safety integrity The use of human vigilance is an inferior approach

Principle 9 Lookouts should, in addition to the requirements contained in Principle 5 -

a wear a clear means of identification

b have reliable means of communicating warnings

Principle 10 The safety of an individual or group at risk will need to be planned and managed by a responsible person who should in addition to the requirements contained in principle 5.

a wear a clear means of identification

b plan and write down the safe system and brief all those affected by it

Principal 11. The safe system of work will need to include provision of sufficient warning time to enable those at work to clear the track of obstructions and move to a place of safety.

Principal 12. On receipt of any warning, people will need to immediately move to a place of safety leaving the track safe, and acknowledging the warning

D. Further Considerations

Principle 13. Approaching trains should be conspicuous to people on the track, and people on the track should be conspicuous to the drivers of trains, but audible warnings from trains should not be relied upon for safety.

E. **Management of Health and Safety**

Principle 14. Safety management principles will need to be applied to work on the track, including -

a planned and recorded monitoring of the correct application of the safety systems,

b. recording and investigation of accidents and near misses,

c. encouraging the reporting of near misses in a full and frank manner,

d having systems to implement necessary changes to the safety systems revealed by any of the above

APPLYING THE PRINCIPLES

In 1992 British Rail initiated an in depth study of safety of workers on the line A senior manager re-analysed in depth all fatal accidents to workers on the line. and studied practice in other countries A report was prepared which made a series of recommendations requiring significant changes in methods of work and railway operations. This work culminated in changes to the systems of work, which were implemented on 22 April 1995, and applied the principles detailed in the RIAC publication.

The introduction of these procedures was preceded by a significant campaign of training, briefing and extensive use of publicity materials, in view of the step changes involved from the earlier methods.

These changes introduced the concept of Red and Green Zones for work on the track with clear requirements for each. In both cases, a Person In Charge of Work (PICOW) is the person responsible for planning and managing matters associated with the track safety of those in his group (Principles 10 and 11).

A comprehensive new Track Safety Handbook is issued, on a personal basis, to all PICOWs and those who hold a Personal Track Safety Certificate.

RED ZONE

Red Zone working involves the provision of systems (Principle 4), to provide warning of approaching trains, ie lookouts (Principle 9) and/or technical warning systems (Principle 8)

Red Zone working is not permissible during the hours of darkness unless technical warning systems are used or special arrangements are made to reduce the speed of trains Safety management arrangements (Principles 6 and 7) need to be in place for any Red Zone Working

All staff have to be trained and certified to work on the track, and hold a Personal Track Safety Certificate (Principle 5)

GREEN ZONE

A Green Zone is one in which work is segregated from trains This is achieved by one of two methods

When trains are not running at all on the lines concerned, usually under engineers possession (Principle 1) or

When the work is segregated from trains when the line is open to traffic (Principles 2 and 3)

The procedures allow for this to be achieved by one of three methods:-

a. Safeguarded - Where arrangements are made by the PICOW for movements to be stopped on all lines These arrangements include:-

   i. Use of a track circuit operating device to occupy the track circuit and hold signals at red in areas of track circuit block.

ii. *Disconnection of signals by suitably qualified staff thereby maintaining signals at red.*

iii Signals replaced to red by the signalman with the provision of handsignalmen at the protecting signal as a reminder

iv Emergency protection applied by the signalman which involves replacement of signals to danger but does not require any of the procedures outlined above This is only available when initiated by the signalman.

b Fenced - Where the PICOW arranges for temporary fencing to be erected between the site of work and the nearest line open to movements

c. Separated - Where there must be a distance between the site of work and the nearest line remaining open to movements of at least 2 metres, and a Site Warden is appointed to warn anybody straying towards the pre-determined safe limit The Site Warden requires to be trained, certificated and provided with a means of visual identification

Wherever possible, Green Zone working is required, in view of the inherently greater safety provided.

REVIEW BY HM RAILWAY INSPECTORATe

The changes of April 1995 were significant and far reaching A review carried out by HM Railway Inspectorate early in 1996 revealed that in many areas implementation was falling short of expectations. A report was produced which identified the following problem areas:-

a. Red Zone working requirements were not well defined on site, and were thus open to interpretation.

b The availability of Green Zones depended on the time intervals between trains, and, in areas with an intensive service, it was unlikely that they would be granted for maintenance under traditional arrangements

c In many cases, PICOWs were carrying forward previous practices to work Red Zone for routine maintenance work, in the absence of guidance on ways of obtaining Green Zones.

HMRI made the following recommendations -

a a common understanding must exist throughout the industry of the requirements related to Green Zone working

b routes and train services should be examined to determine the availability of Green Zone working and these should be documented

c. risk assessment techniques should be used to assess the comparable hazards of Red and Green Zone working

d Staff resources in relation to Green Zone opportunities should be examined

e. Monitoring should be initiated with the aim of maximising and promoting the use of Green Zone working

The recommendations were discussed with Railtrack, contractors and trade unions.

Railtrack has expended considerable effort in documenting the availability of Green Zones, and in preparing line procedures to reinforce the facilitation of Green Zone working and these have been introduced during April 1997. HM Railway Inspectorate will monitor progress.

THE FUTURE

Through the forum of a group comprising of representatives of the industry, known as the Track Safety Review Group, a number of systems are being trialled with a view to reducing dependency wherever possible on human systems (Principle 8).-

a IWS - Individual radio warning system for track personnel

b. Safetrack - radio based lightweight track warning system for work groups

c Minimel - a form of automatic warning system which is activated by a train striking treadles which are fastened to the rail at a pre-determined distance, and;

d ARW 5/2 - a treadle operated audible and visual warning system

Potential areas of concern to HM Railway Inspectorate, in relation to track safety, includes.-

a The use of agency or self-employed staff, who do not have a well-founded safety management organisation directly backing them up

b. The use of part-time or multi-functional staff, whose work in the railway environment forms only a small part of their working year.

c. The geographical mobility of companies' activities, thereby losing the benefit of local familiarity hitherto a feature of track work.

d. Fitness standards and safety competencies, i.e. PTS and PICOW

e. Competencies related to skills required for the work.

f. Arrangements for updating documentation relative to work procedures.

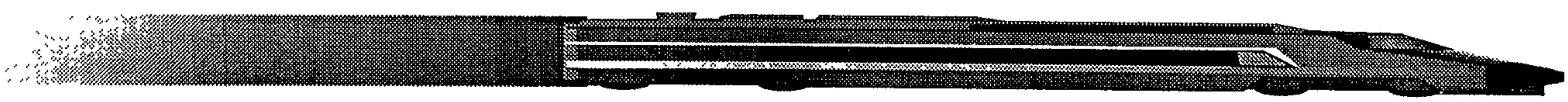
g. Number of hours worked, and intervals between duty

h. Provision of adequate welfare facilities and personnel protective equipment

It is pleasing to report that fatalities to staff at work on the track in Great Britain have never been lower The efforts made by the railway organisations, encouraged by HM Railway Inspectorate, to reduce staff accidents appear to be working There is however, no room for complacency if the record is to be maintained and improved

WORK ON THE TRACK
THE BRITISH EXPERIENCE

S S J Robertson
HM Chief Inspector of Railways
Health & Safety Executive, UK



UK RAILWAY STRUCTURE

- Seperation of infrastructure provision from train operations.
- Thirty seperate companies operate passenger and freight services.
- Maintenance and renewal in the private sector

HM Railway Inspectorate

- Founded in 1840.
- Part of Health & Safety Executive.
- Inspection of new works.
- Accident investigation
- Safety performance.
- Enforcement powers.

Track Safety

- Most common single type of fatal accident.
- Risk higher than industry average
- Applicable UK safety legislation

Applying the principles

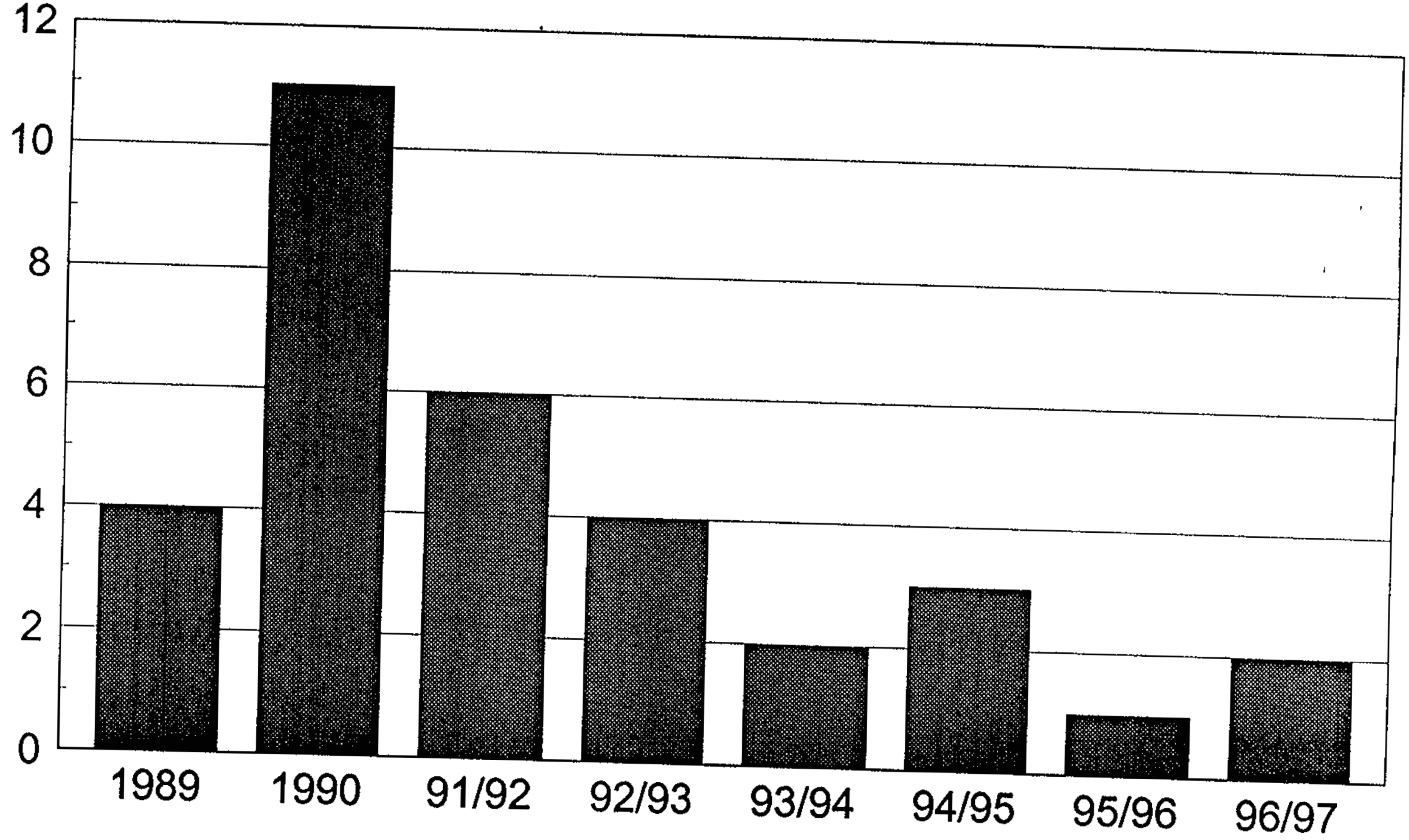
- Accident analysis
- Study of practice in other countries
- Changes to system of work
- Red Zone/ Green Zone concept
- Review by HMRI

SLIDE SHOWING
RED ZONE
WORKING LOOKOUT
PROTECTION

SLIDE SHOWING
USE OF TCOD

SLIDE SHOWING WORK IN SAFEGUARDED AREA

FATAL ACCIDENTS TO TRACKMEN 1989 - 1996/97



RAILWAY INDUSTRY ADVISORY COMMITTEE (RIAC)

- Established 1978 by HSC
- Members from employers and trade unions.
- Working group to investigate track safety
- Publication"Railway Safety: The prevention of risk to workers on the track"
- 14 Principles for safe working.

THE FUTURE

- Trials of technical warning systems
- Reduction in dependancy on human systems
- Risks presented by changing labour arrangements
- Need for continued vigilance

International Rail Safety Conference

1997 LUCERNE

21 May - 23 May 1997
Swiss Transport Museum, Lucerne, Switzerland

Paper 9706

Olle Mornell

Reducing Human Errors at Level Crossings in Sweden

Publisher
2000 International Rail Safety Conference

Schweizerische Bundesbahnen
Chemin de fer fédéraux suisses
Ferrovie federali svizzere
Swiss Federal Railways

INTERNATIONAL RAILWAY SAFETY CONFERENCE (IRSC) 1997
21 to 23 May, Lucerne / Switzerland

PAPER:	**Human Factor Reducing Human Errors at Level Crossings in Sweden**
PRESENTED BY:	**Mr. Olle Mornell Senior Safety Administrator**
DATE:	**21.05.97**
SESSION:	**I**
TIME:	**0950-1020**

Curriculum Vitae

Olle Mornell (Mr)

Olle Mornell is employed at the Swedish National Rail Administration (Banverket) since 1987 and he has been in charge of one of our engineering groups regarding signalling. In the aim of writing down "unwritten rules" he managed completing documents regarding planning regulations and requirement specifications.

Olle Mornell is recently assigned as a senior safety administrator. His earlier background, after completing an upper secondary engineering course 1975, covers signalling and electrical maintenance and signalling engineering at Stockholm Transit (SL). He has also been responsible for the electrical installations at a sewage treatment plant.

BANVERKET
(Swedish National Rail Administration)
Olle Mornell

29 April 1997

Reducing Human Errors at Level Crossings in Sweden

Sweden has 9600 level crossings, 1100 of which have full barriers, 1000 have half barriers and 700 have lights and bells. When the speed of the railway exceeds 160 km/h, the protective measure is full barriers with an obstruction detector. When speeds exceed 200 km/h, level crossings are not allowed in Sweden.

Research and development in the 70´s pointed out that the accident quota was higher at crossings with lights and bells than at other crossings. Lights and bells are not always a bad choice, but in many locations they are not appropriate. A decision was taken to convert lights and bells into barrier protection or to close such crossings altogether wherever possible. The objective for 1994 was to convert or close crossings with a Traffic Flow Product (trains x cars) exceeding 1600 per day. The reduction of crossings with lights and bells has been successful and for the year 2004 the objective is to convert or close such crossings where the TFP exceeds 1000.

Measures have also been taken to improve barrier protection. Tests have been conducted with *rumble strips, reflector gantries, elevated signals* and *hanging reflectors*. A technical evaluation of signals equipped with *Light Emitting Diods* (LED) is currently in progress.

Rumble strips proved unsuccessful. The reason being that drivers often zigzagged into the exit lane to avoid the strips. There were no strips on the exit lanes due to the risk of cars braking after the crossing causing rear end collisions. Rumble strips could be a possible solution only if traffic islands separate entrance and exit lanes.

Reflector gantries and elevated signals have been evaluated at one particular crossing. A video camera registered the traffic in three different studies. The first study was conducted before the reflector gantries were installed. The next study was conducted when the gantries were installed and the last study when additional elevated signals were installed. By analysing the video tapes, the road speed and the braking point could be calculated and the stop signal obedience observed. When the reflector gantries and elevated signals had been installed, drivers were able to detect the crossing at an earlier stage - which was also the intention. However, the test was conducted in a small village where almost everybody knew that if the warning started, the barriers could be down for a time which many considered too long. The result of the extra equipment was that many drivers increased their speed and disobeyed the stop signal aiming to pass through the crossing before the barriers were lowered.

Hanging reflectors are used to enhance the visibility of the barrier in order to reduce the risk of barrier collisions. In Sweden the influence of (wet) snow must be taken into consideration. Red and yellow plastic bars with a reflecting material are used. No evaluation has been done. Some problems with vandalism of reflectors have arisen.

Signals currently in use do not comply with the Road Administration´s requirements for regular traffic lights. Due to a limited battery power backup, it is not possible to install lights with greater brightness. However, the development of new light emitting diods has opened up new possibilities of improving brightness and is now under technical evaluation. LEDs are 4 times brighter than regular lights with the same energy consumption and comply with the Road Administration´s requirements. No specific behavioural research is planned but fewer accidents are expected.

Reducing Human Errors at Level Crossings

Results of various measures taken to reduce human errors at level crossings

Olle Mornell
Swedish National Rail Administration
Banverket
Sweden

Number of Crossings in Sweden

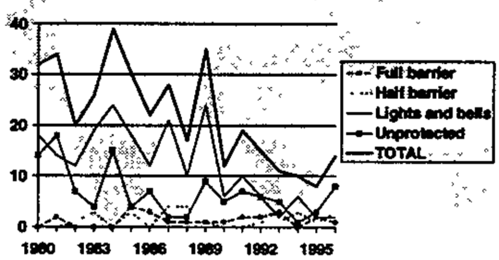
	1997	1990	1980
Full barriers	1 100	1 200	1 400
Half barriers	1 000	750	400
Lights and bells	700	1 550	2 200
Unprotected	6 800	13 000	20 200
TOTAL	9 600	16 500	24 200

Accident Quotas

(Average 1991 - 1995)

	Accidents/year	Risk factor
Full barriers	0.00542	1
Half barriers	0.00999	1.8
Lights and bells	0.01831	3.4
Unprotected	0.00220	0.5

Number of Fatalities at Level Crossings



Measures to Improve Crossings with Lights and Bells

- Lights and bells have the highest number of fatalities
- If Traffic Flow Product (trains x cars) > 1000 (objective for 2004)
  - close the crossing

  or
  - install barriers

Measures to Improve Detection of Level Crossings

- Rumble strips
- Reflector gantries
- Elevated signals
- Hanging reflectors
- Improved light signals

Rumble Strips

Test:
- Strips before the crossing (entrance lane only)

Result:
- Drivers zigzag to avoid the strips (thus increasing the risk factor when entering the crossing in the wrong lane)

Evaluation:
- Rumble strips useful only when a traffic island separates entrance and exit lanes

Reflector Gantries

Test:
- When speed on railway > 160 km/h
- Where it is difficult to detect the crossing

Result:
- No reduction of road speed
- Perception slightly improved

Elevated Signals

Test:
- Where it is difficult to notice the regular signals

Results:
- Detection improved
- Fewer barrier collisions
- Acceleration of road speed before closure of barrier (due to drivers' awareness of long waiting time)

Stop Signal Obedience

Test results at a level crossing (with an unreasonable waiting time)

	Total # crossings	Stop signal disobeyed	Percent
Barriers only	87	16	18%
Gantries added	114	31	27%
Gantries and elevated signals added	99	33	33%

Reflector Gantries and Elevated Signals

Evaluation:
- Useful when
  - crossing is difficult to detect
  - frequent barrier collisions
- Not useful when drivers perceive waiting time as too long

Hanging Reflectors

Results:
- Enhances the visible area of the barrier
- Likely to prevent pedestrian trespassing
- No problems with wet snow
- Occasional vandalism on reflectors

Improved Light Signals

Test (in progress):

- LED signals

Results:

- 4 times brighter with same energy consumption
- Complies with the Road Administration´s requirements
- Fewer accidents with LED signals are expected

International Rail Safety Conference

1997 LUCERNE

21 May - 23 May 1997
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Paper 9707

Gerald Churchill

Human Reliability in the Safety Related Jobs at RATP

Publisher
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Schweizerische Bundesbahnen
Chemin de fer fédéraux suisses
Ferrovie federali svizzere
Swiss Federal Railways

INTERNATIONAL RAILWAY SAFETY CONFERENCE (IRSC) 1997
21 to 23 May, Lucerne / Switzerland

PAPER: Human Factor
Human Reliability in the Safety-related Jobs at RATP

PRESENTED BY: Mr. Gérald Churchill
Executive Manager

DATE: 21.05.95

SESSION: II

TIME: 1040-1110

CURRICULUM VITAE

Gérald CHURCHILL

Graduate Engineer from "ECOLE SUPERIEURE D'ELECTRICITE" (French Electrical Engineer National School).

Gérald Churchill is in charge of coordination, development and technical consistency within the Electrical Equipment and Systems Department.

He is the Director's delegate for the management of RATP projects concerning railways, in particular safety related projects.

Previously, he was responsible for the design of safety systems for all RATP railways and road modes. He managed design projects, safety audits and software safety certification.

After having begun his career in the RATP Rolling Stock Department, he has held positions of responsability for the design of fixed installations (signalling, ATO, ATC, ATP) and of rolling stock (Metro and Regional Express Rail).

Gérald is the RATP representative in several European Railways Standardisation working groups and is Vice-President of the signalling and communication standardisation french national committee.

He is also fellow of the Institution of railway Signal Engineers.

International Railway Safety Seminar
LUCERN - May 1997

HUMAN RELIABILITY IN THE SAFETY-RELATED JOBS AT RATP

D. SILHOL - RATP
G. CHURCHILL - RATP

12, avenue du Val de Fontenay
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FRANCE

For 5 years now, the RATP has tried to quantify human error rate. The first works were about the overrunning of a signal-at-danger and about the errors made by the traffic controllers of the Metro centralised traffic control room when re-energising a section. They were presented in Angers during the International Railways Safety Seminar '94

This paper presents the work that has been done since then and the state of the progress of our thoughts.

Reminder on the objectives of quantification
RATP studies on quantification are still very few. At the moment, they deal with:

the error that can be blamed on the operator,

in the field of railway operation and maintenance:
operation activities, that means directly linked to transport, mainly driving activities and maintenance of railway installations: for example signalling and track equipment.

for repetitive tasks for the performance of which no complicated information treatment is needed. A regulation or a procedure such as a check-list must be simply applied in that case.

They respond to four main needs:

- To know the specifics and the performance level of safety-related activities in the field of urban railway transport.
- To compare them to
    - the generic figures in guidebooks, for example the classical Swain's tables.
    - the performance of other companies, a good occasion for it being the Railway Safety Seminar,
- To follow the evolution up internally: this is the part of safety management allocated to operational managers.
- the last objective of this quantification is the most ambitious and is far from the end: to take into account human factors starting at the very beginning of the design of transport systems

These kinds of studies in the field of human factor researches are the main concerns of most companies.

Three new studies
Three new studies are completing our works presented in Angers. They are all related to driving job but in different environments.

1. Overrunning of a stop signal on a Metro line
   In other words, this occurs when a signal-at-danger is run past. Line 13 volunteered for a new study same as the one carried out on Line 5 two years ago.

2. Overrunning of a stop signal on a RER line
   This is focusing also on the overrunning of stop signals, but on the RER Line A, and especially on the furthest parts of the line, which are not equipped with SACEM system. In fact, there is no more overrunning which can be blamed on the driver since the SACEM continuous speed control system has been put into service at the end of 1988 between Vincennes and Nanterre. The concern of the study is about the western RATP-operated branch, from Nanterre to St Germain en Laye and the eastern RER branches, from Boissy St Léger to Vincennes and from Chessy Marne-La-Vallée to Vincennes.

3. Shunting errors for work trains. Those trains are used at night for the maintenance of the track and switch gears. They are prepared during the day at La Villette workshop by specialised drivers: foreman shunters and drivers, which are responsible for the forming of trains, their movements and the loading.

Methodology
The general principle is the same for the three studies: a frequential approach has been used. We search for a probability which is a measure: it conveys the state of the present situation and is based on data learnt from experience.
The probability is the ratio between the number of recorded errors and the number of situations where such an error can occur.
For the Metro and the RER, the number of errors is exactly known thanks to the on-board recording systems. Every error is detected. The number of situation where an error can occur, in other words, the number of stop signals encountered by all the drivers during the observation period, is evaluated statistically: the calculation is based on a poll made on a sample of drivers who have been accompanied in the cab.
The result is an estimation by intervals accompanied with a confidence level of 95%.

Besides, in the case of work trains, the denominator - the number of situations where a shunting error is possible - is calculated starting from an analytical breaking down of tasks. The result is an estimation by intervals linked to the imprecision, but the associated level of confidence cannot be provided.

Results

Details on the methodology and the calculations are given in annexes. Only the main results are provided here.

1. Line 13

   - 17 overrunning per year on average
   - between 369000 and 737000 encountered signals-at-danger for a 95% confidence level

   This is similar to Line 5 results in terms of human error probability: between 3.10^{-5} and 7.10^{-5} with a 95% confidence level.

2. RER line A out of SACEM zone
   - 10 overrunning per year on average
   - A number of encountered stop signals significantly less compared to Metro lines: between 64000 and 98000 stop signals,

   which leads when considering only the final result to a probability of running past a stop signal comprised between 10.10^{-5} and 16.10^{-5} with a 95% level of confidence.

3. Work train

   - 3 to 5 overrunning over the 5 years observation period that was retained,
   - between 82000 and 130000 elementary manoeuvres over 5 years,
   - this gives a human error probability comprised between 2.10^{-5} and 6.10^{-5} but without any level of confidence.

Interpretation of the results

Whereas the results on line 13 and work trains confirm the results of 1994, RER figures are striking because they are significantly different from the previous values obtained for simple tasks:

- 3 to 7.10^{-5} for L13 - L5,
- 2 to 6.10^{-5} for work trains
- 10 to 16.10^{-5} for RER

So what can be concluded, what is to be taken in from these results ?

Can our conclusions be retained concerning human performance, which were until now:
- no specifics linked to the various natures of jobs performed in safety-related activities, only a distinction between simple task / complex task.
- human error probability of 3.10^{-5} for a simple task
2.10^{-4} for a complex task,
(provisory conclusion of the works presented in Angers)

At the end of those three additional studies, there is no fundamental reappraisal but a revision of the interpretation and use of those figures.

The following must be retained:

1. A rough range

   The evaluation of human performance probability does not provide a figure with the associated properties but only a rough quantified indication in terms of a power of 10.

   Compared to the conclusions 10^{-5} / simple task, 10^{-4} / complex task, the gaps are qualitative and not quantitative: 2.10^{-5} is not twice as best as 4.10^{-5}, it is simply best.

2. A value with a certain confidence level, 95 % when the random samplings are made in good conditions. This is a difficult notion to make operational managers understand: in reality, the actual figure can be outside the estimation interval.

3. A figure which is very difficult to compare with others considering only the quantitative value. Comparisons must be associated with qualitative analyses on operating conditions.

   For both Metro lines, L13 - L5, results are similar because:
   - signalling is the same
   - driving rules are the same
   - Automatic Train Operations (ATO) are the same

   Between Metro and RER, this is far more tricky:
   - Signalling is not exactly the same. On RER line, a stop signal is preceded by a warning signal that the driver must validate. Therefore the mental sequence for respecting a signal is not the same.

   - Using the ATO is not possible on RER lines.

Actually, what performance is evaluated is <u>the human factor in a certain operating environment</u>.

Conclusion and what comes next

At the end of this work, RATP confirm the importance of human factor quantification in order to assess the performance in terms of safety, providing the safeguarding of the above precautions on this measure. However, as a consequence of these results, new studies have been launched:

- the distinction, or more exactly the definition simple task / complex task is questioned anew at the moment.

- qualitative studies are already being carried out with safety engineers and human sciences experts associated to people working in the field in order to evaluate better the operating factors that influence the level of performance.

But these studies have already led to applications.

For operation managers, qualitative and quantitative studies lead to concrete actions:

- for drivers: safety information/training

- on driving environment:

  improvement of the visibility of some signals

  rules modifications

Concerning human factor being integrated at the very beginning of design, quantification works are used for choices of design and in the apportionment of safety targets of automated driving systems taking into account analysis of the whole system ATC + driver.

Actually, we can give here an example of the specification of the continuous speed control system which will equip RER Lines A and B. In this specific application, the whole ATC/driver system must respect a safety level as least as good as SACEM, means 10^{-9} /hour/equipment although it is not necessary that each one of the two components reach such a level provided there is no common modes.
The design choice was finally: the driver works with lateral signalling, the continuous control system as a protection role and is only active in case of a human error.

Hence a safety target reduced to $10^{-5}/10^{-6}$ per hour per equipment, which means design/manufacturing/validation tools and methods to be used less demanding than for a target of 10^{-9}, in terms of time and money.

Finally, other new fields of researches have been identified:
- errors put right by the operator: man as a reliability element
- safety in the field of maintenance and in the management of working areas.

Less classical methodologies should also be used: bayesian techniques for estimating data and bayesian networks.

ANNEX 1

Violation of a stop signal on a Metro line

Metro line 13 Chatillon Montrouge-St Denis collaborated in trying to quantify overrunning of stop signals by drivers, this means mainly signals-at-danger. Line 5 Place d'Italie-Bobigny had participated in a similar study in 1992.

$$\Pr[\text{running past a signal-at-danger}] = \frac{\text{number of signal} - at - \text{danger overrun}}{\text{Number of signals} - \text{at} - \text{danger encountered while in Manual Driving}}$$

The numerator is detected by technical means and is also followed up very carefully by operation managers. Therefore, it is assessed with great certainty. This is not the same for the denominator which is determined thanks to a statistical estimation made on a poll. This poll is the result of a sample made on drivers accompanied in their cab in October 1995.

The sample must be representative of the driving activity performed every week on the entire line, on main lines and on secondary lines. Finally, a sample of runs was retained and stratified by interval (stratum 1: interval < 4mn, stratum 2: interval ≥ 4mn) and completed with services with no passenger (stratum 3: sidings and shunting). This methodology is slightly different from the one used for Line 5 study (since the sample was composed of 10% of weekly services) and has the advantage of reducing poll rate so that data collection is lightened.

Results

Number of encountered signals-at-danger while in manual driving in the sample

Number of encountered signals-at-danger while in manual driving per week	Population size (per week)	Sample size	Poll rate	Average number of signals-at-danger in manual driving	95% confidence interval of the mean
STRATUM 1	3566	158	4.4%	2.461	0.9697
STRATUM 2	1524	50	3.3%	1.111	0.5046
STRATUM 3	79	79	100%	2.089	0.7566
Total				10,634.121	3,542.93

Results over one year

The annual number of encountered signals-at-danger while in Manual Driving is deduced from the above result: there are 95 chances in a hundred that the number of signals encountered at-danger **during a year** by all the Line 13 drivers while in manual driving is **comprised between 368,732 and 737,204**.

Probability of running past a signal-at-danger

The **average value** is **24 overrunnings per year** (slippery mean over 34 months). By applying the above formula, the result is the following:

There are 95 chances in a hundred that the probability of running past a signal-at-danger on Line 13 is comprised between $3.25\ 10^{-5}$ and $6.51\ 10^{-5}$.

ANNEX 2

Violation of a stop signal on RER line A

An operation similar to the one performed on Metro lines 5 and 13 was conducted on RER line A. One part of this line, the central part, is equipped with a continuous speed control system, the SACEM system, and overrunning can no more be blamed on the driver. Therefore, the study is performed on RATP zones not yet equipped with SACEM system.

Methodology

$$\Pr[\text{running past a stop signal}] = \frac{\text{number of stop signal overrun}}{\text{Number of encountered stop signals}}$$

RER signalling rules prescribe that the driver must stop when encountering fixed signals like semaphore, absolute stop or violet square[1] signals, as well as doubtful signals or signals out which, in normal operation, are likely to be demanding to stop.

Overrunnings are all known exactly. On the other hand, a statistical study is necessary to estimate the number of stop signals encountered by the drivers. 10% of weekly missions were polled during February 1996. Someone present in the cab noted down the state - the colour - of every encountered signal on the main line as well as in terminus as far as the train was out of the central zone.

Results

Results of the poll

Days	number of polled missions	number of total missions per day	Average number of stop signals per mission
Monday	70	569	0.371
Tuesday	70	569	0.414
Wednesday	59	569	0.661
Thursday	75	569	0.520
Friday	67	569	0.418
Saturday	52	414	0.269
Sunday	44	414	0.318
Total	377	3672	0.425

[1] stop signals on station sidings

Number of encountered stop signals

After applying calculation formulae applicable to polls by samples, the result is the following:

There are **95 chances in a hundred** that the average number of stop signals encountered on RER line A out of the SACEM-equipped zone is:

per week	comprised between	**1227 and 1892**.
per year	comprised between	**63,804 and 98,379**.

ANNEX 3

Work trains shunting error

Work trains are formed, loaded and moved all day long at La Villette workshops. Their movements need foreman shunters and drivers. These roles are played in shifts by specialised drivers.

The foreman shunter is responsible for the safe traffic of trains in his area. His task is to allow the shunting of a single train at once after ensuring that the route is free and that switch gears are in the right position.

The driver checks his train, does the shunting, and verifies the route during the movement, in redundancy with the foreman shunter.

The objective of the study is to determine what is the probability for a foreman shunter controlling a shunting, or for a driver doing this shunting to make an error leading to a severe accident: derailment, bumping, collision.

Methodology

Again, the approach is based on frequencies:

$$\Pr[\text{work trains shunting error}] = \frac{\text{number of accidents}}{\text{Total number of manoeuvres}}$$

Each accident is known and is analysed specifically. Its origin can be blamed either on an equipment failure (track, train) or on a human shunting error (foreman shunter or driver).

It is not always easy to put things in perspective. Moreover, even if considering a period of many years, occurrences at the limits of the interval make it difficult to guarantee a specific figure. That is why the number of accidents that can be blamed on operators is imprecise in this study.

For foreman shunters: 3 over 5 years $\leq \mathbf{N}_{\mathbf{accident}} \leq$ 4 over 5 years
For drivers: 4 over 5 years $\leq \mathbf{N}_{\mathbf{accident}} \leq$ 5 over 5 years

The denominator must also be evaluated. The total number of elementary manoeuvres controlled over the 5 years observation period has to be determined. A subtle knowledge of the foreman shunter's job and of the preparation of work trains leads to the breaking down of $N_{manoeuvres}$ in the following way:

$$N_{manoeuvres} = n_t \,.\, n_{m/t} + J \,.\, n_{mdf}$$

The meaning and value of each abbreviation is provided in the table below:

n_t	number of trains over 5 years	*13 924 trains*
$n_{m/t}$	Number of manoeuvres needed to unload and then load a train whose composition is not changed	*$5 \leq n_{m/t} \leq 8$ manoeuvres per train*
J	Number of days worked in 5 years	*5 . 251 = 1255 days*
n_{mdf}	Number of manoeuvres per day for forming new trains by unhitching and coupling of wagons	*$10 \leq n_{mdf} \leq 15$ manoeuvres per day*

Finally, the resulting total number of elementary manoeuvres requested over 5 years is the following:

$$82\,170 \leq N_{manoeuvres} \leq 130\,217$$

Results
The probability of work train shunting error is:

For foreman shunters, comprised between $2.3\ 10^{-5}$ and $4.8\ 10^{-5}$
For drivers, comprised between $3.1\ 10^{-5}$ and $6.1\ 10^{-5}$

International Rail Safety Conference

1997 LUCERNE

21 May - 23 May 1997
Swiss Transport Museum, Lucerne, Switzerland

Paper 9708

Yasuyuki Yuzuki

Safety Management: Union's Challenge to Safety for these 10 years

Publisher
2000 International Rail Safety Conference

Schweizerische Bundesbahnen
Chemin de fer fédéraux suisses
Ferrovie federali svizzere
Swiss Federal Railways

INTERNATIONAL RAILWAY SAFETY CONFERENCE (IRSC) 1997
21 to 23 May, Lucerne / Switzerland

PAPER:	**Safety Management** **Union's Challenge to Safety for these 10 Years**
PRESENTED BY:	**Mr. Yuzuki / Takahashi** **President of JREU**
DATE:	**21.05.95**
SESSION:	**II**
TIME:	**1110-1140**

International Railway Safety Conference 1997
21–23 May 1997 Lucern, Switzerland

UNION'S CHALLENGE TO SAFETY FOR THESE 10 YEARS

By
Yasuyuki Yuzuki
President of JREU

1, Introduction

East Japan Railway Workers' Union (JREU) was formed in March 1987 when the former JNR was privatized. Since then we have developed our activities based on health and safety. I would like to report our challenge for these ten years, when we have sought a safer and more reliable railway system since privatization.

For the first year that the new JR started, serious accidents did NOT occur. However, in March ~~1997~~ 1988, just before the month of the first anniversary, the Arcadia, special–made entertainment train had a fire accident caused by overheating of an exhaust. In August 1988 a freight train derailed and in October 1988 another freight train derailed and collided. Fortunately, there was no casualty but on 5th December 1988 a serious train collision accident occurred. The train driver and one passenger were killed and many were injured by the accident. The cause was that one train collided from behind with another which was stopped at station from behind. The former did not notice the red signal.

These continuous serious accidents made our starting point to challenge safety. At first, as a trade union we began to discuss how to prevent such serious accidents to protect passengers and our union members. In the meeting of the joint management council JREU expressed its opinion regarding safety that when accidents or disasters were expected, the train should be stopped without hesitation. At the same time we stated " the declaration of eradication of accidents ". We intended to change the idea that train operation took precedence over safety.
However, the reality of our workplaces that we faced was that managers pursued the responsibilities of workers who were involved in accidents, then tried to control more severely under the name of "accident preventive measures".

These managers' conduct produced workers' distrust against the company and their managers.

We believed that unless we changed this corporation culture we could not keep safety in our workplaces. From the beginning of 1989 JREU started the campaign "challenge to safety" .

2, Safety issue is common between union and management

Our first challenge is working to change corporate culture in workplaces. The company stressed in its policy, " Safety first " but in reality employees were working in completely different conditions from the policy.

Train operation always demanded " accuracy " and delay was regarded as kind of evil. Therefore, a culture in which sometimes accurate operation was given a priority over safety had exsisted. On one hand we said " safety first " but on the other hand when sensing danger we hesitated to stop trains. Why could we not stop the train ? Partly because we feared being pursued about our responsibilities and partly because we had distrust in the company's safety management and measures.

JREU appealed to our members to have courage that they could stop trains without hesitation for safety. We tried to solve the contradiction between the company's policy and reality at work and to remove the employees' and the company's distrust. At the same time we created discussion of safety issues in our workplaces. We talked to each other about what we felt or what we experienced. We wanted to create a mood and environment that our members could talk and point out problems on safety freely in their daily work.

On the basis of these activities as a trade union we held a safety symposium in September 1989. In the symposium representatives discussed safety measures regarding particular accidents, safety issues in workplaces and roles of trade union concerning safety. We raised the safety issue as one of our union's priority problems to tackle.

As a result, our union members and the top manager in the workplace could discuss safety issues, such as case study of accidents, cause and background and so on. In October 1991 the 2nd Safety symposium was held, gathering 1,200 representatives from our union under the theme of " Let's learn from accidents and let's exchange experiences " and " Aim for a safer railway ".

Our most valuable lesson we had acqured was that the safety issue was common between union and management and to keep safety was achieved only when labour and management could cooperate with each other. We had learned that management-dominated relations, for examples, " Managers control everything " or " Managers always rule and employees always obey ", were only obstacles to establishing a system of safety.

2, The most important thing was investigation of causes of accidents.

Through the series of safety symposium we realized keenly it was important to learn lessons not only from JR's cases but also from other industries and overseas countries. We would like to restore railways in the 21st Century. We called the

International Railway Safety Conference to develop railway safety and to share lessons widely, crossing borders of industries and countries. The management of JR East company agreed with holding the conference and called together to overseas organizations. From 30th October to 1st November 1990 the first International Railway Safety Conference was held in Japan, with participating railway management and unions from 30 countries. I think some of today's participants took part in this conference in Tokyo. On the day before the conference, unions from 16 countries had their International Union Safety Conference. Representatives from unions reported problems and measures in their countries and shared experiences.

In the conference, overcoming the differences of people, culture and religion and standing on the same basis of all being railway people, we discussed seriously how to seek safety and got substantial results. JREU appealed not to pursue responsibilities of the people involved in accidents, but to clear up the cause of accidents. This was the way to decrease accidents radically. This conference became a turning point for JREU. We established our concept, that is, " Do not pursue responsibilities but investigate the cause of accidents", firmly and it made the corporate culture change.

In other words, only pursuing responsibilities of workers involved in accidents was not effective in preventing accidents at all, but had the opposite result. Most important thing was investigation of causes of accidents. I believed that we established the first step of a new corporate culture in workplaces at that time. Participants from our union learnt a lot from the conference as well.

The International Railway Conference was successful but two other unions, called KOKURO (NRU) and TETSUSANRO existing in JR, hindered our planning safety conference. After ten years has passed since privatization of the former JNR, KOKURO has not changed its name, it is still called National Railway Union. They objected to the conferece because they did not like any plans cosponsored by JREU and the JR East company. Today they claimed railway accidents had increased because of privatization and division of the former JNR. This propaganda is completely wrong.

TETSUSANRO, which split up from KOKURO, asked International Transport Workers' Federation (ITF) and foreign rail unions to boycott the International Railway Safety Conference. They said TETSUSANRO had been removed from the conference. It was sponsored by one specific union, JREU. That was the problem.

They also called for a boycott by other domestic trade unions.

Besides these two unions, JR West's top managers denied to attend the conference. They said, " Only managers can deal with safety issues. The union has nothing to do with this matter". I think these managers should be blamed for not regarding unions as their partners in safety management. They ignored existence of unions.

PARTICIPATION OF RAILWAY SAFETY SYMPOSIUM AND INTERNATIONAL RAILWAY SAFETY
CONFERENCE

*RAILWAY SAFETY SYMPOSIUM

	DATE	THEME
1ST	13 SEPTEMBER 1990	FOR THE RAILWAY IN THE 21ST CENTURY
2ND	30 OCTOBER 1991	HUMAN AND SAFETY TECHNOLOGY
3RD	25 NOVEMBER 1992	FOR HUMAN RAILWAY
4TH	5 OCTOBER 1993	MAINTENANCE AND SAFETY
5TH	6 DECEMBER 1994	CHANGE OF RAILWAY AND SAFETY MANAGEMENT
6TH	18 DECEMBER 1995	SAFETY AND HUMAN FACTOR
7TH	16 DECEMBER 1996	SAFETY AND HUMAN FACTOR

*INTERNATIONAL RAILWAY SAFETY COFERENCE (SEMINAR)

YEAR	COUNTRY	THEME
1990	JAPAN	To create corporate culture in which employees seek for safety by themselves
1991	U.K.	no participation
1992	New Zealand	Union's tasks and roles for safety
1993	France	Fatal train accidents of sub−contracted track workers − Its factor and analysis −
1994	Hong Kong	* Strenghtening cab structure − Example : Type 209 train − * Assaults on train crews and station staff
1995	Germany	* Our creative safety measures − Aiming at zero accident * Union and management should work together for railway safety
1996	R.S.A.	* One−man operation and safety − The aspect fron union − * Union's tackling : Improvement of one−man train operation

*JREU SAFETY SYMPOSIUM

1st SEPTEMBER 1989

2nd OCTOBER 1990

*ASIAN RAILWAY SAFETY CONFERENCE NOVEMBER 1993

3, Declaration for accidents eradication

JREU regarded discussion through the labour and management joint council as important thing to keep safety. Union and management top leaders discussed the important safety issues. When union and management agreed, a " Declaration for accidents eradication " and " Labour and management joint declaration " was issued jointly. Through stating labour and management's common position on safety in public, a concerned atmosphere to keep safety in workplaces was created. Union members who were concerned about safety became courageous and confident when they read the declaration.

Today union and management continue to have a " Safety joint council " regularly. Branches of the JR East company and unions of regional headquarters also hold joint councils as well. We seriously discuss accident preventive measures, cause of accidents, safety facilities and investment plans.

< LABOUR AND MANAGEMENT JOINT DECLARATIONS >

1) Accidents eradication declaration : November ~~1998~~ 1988
   by JREU central executive committee
2) The 2nd labour and management joint declaration : 14 May 1992
   " pursuit of safety " was written clearly.
   by JR East Co. president Shoji Sumita
   JREU president Akira Matsuzaki
3) Joint statement : Aiming for accident eradication : 5 December 1992
   by JR East Co. and JREU
4) Safety declaration : Challenge to accidents extermination : 8 November 1994
   by JR East Co. and JREU
5) The 3rd labour and management joint declaration : ~~8 November 1994~~ 1 JULY 1996
Regarding " pursuit of safety ", the following items were stated :
Importance of discussion in joint council, development of " challenge safety Campaign ", creation of corporate culture ; not pursuing individual responsibility, but investigating accidents' causes, pursuit of safe operation and prevention of dangerous obstructions to trains.

4, " Exchanging risk information " was valuable

Ten years has passed since JREU challenged safety. We have learnt how accidents occurred in our workplaces, other industries and other countries. Now I would like to review our 10-year activities of " challenge to safety ".
At first, I would like to talk about awareness of safety in workplaces. I sent out

questionnaires to 1,200 union members to review our activities' reaction on February 1997. 1,164 answered and the rate of collection was 97 %.
The results are as follows :

SAFETY AWARENESS IN WORKPLACES – QUESTIONNAIRE ON SAFETY
< QUESTIONNAIRE REGARDING SAFETY – SAFETY COSCIOUSNESS IN WORKPLACES >

February 1997

Q1. Which is the most important to prevent accidents ? Choose five from the following list.

Items	1997/2 %	1993/2 %
1, Stance of top management	26.5	22.1
2, Stance of management section (supervisor)	16.0	7.2
3, Financial support	12.0	11.6
4, Improvement of safety facilities	47.5	19.4
5, Improvement of equipment in rolling stock	23.0	6.2
6, Improvement of safety rules and regulations	12.0	1.8
7, Improvement of environment in workplaces	45.5	17.5
8, Devotion to work	25.5	15.4
9, Stance of supervisors in workplaces	24.5	14.0
10, Environment of workplaces	42.0	16.6
11, Exchangeing risk information	31.5	2.7
12, Promotion of " Challenge Safety " campaign	13.0	1.9
13, Improvement of accident prevention education	17.0	2.2
14, Individual awareness of safety	62.5	34.9
15, Positive development of technology	13.4	3.4
16, Implementation of general safety inspection	7.0	1.3
17, advice from seniors	20.5	1.4
18, Implementation of basic actions	52.0	15.3
no answer	10.0	2.4

Q2. Tell about evaluation of safety in your workplace

Items	1997/2 %	1993/2 %
1, Highly evaluated	33.9	41.0
2, No change	46.3	25.2
3, Anxieties somewhat increase	14.3	31.5
4, Do not know	4.2	2.0
no answer	1.2	0.2

Q3. Do you know about " Challenge Safety Campaign " implementing in your workplace

Items	1997/2 %	1993/2 %
1, Yes, I know.	55.4	60.3
2, Yes, in some way.	34.1	27.6
3, No, I don't know well.	8.1	9.6
4, No, I don't know at all.	1.1	2.3
no answer	1.2	0.2

Q4. What do you think about " Challenge Safety Campaign " ?

Items	1997/2 %	1993/2 %
1, Interested very much	35.0	~~8.4~~ 13.6
2, Interested	45.7	~~56.7~~ 53.9
3, Less interested	16.0	~~31.9~~ 28.6
4, Not interested	2.2	~~2.1~~ 3.5
no answer	1.1	~~0.3~~ 0.3

*

Q5. Tell the present situation of " Challenge Safety Campaign " in your workplace.

Items	1997/2 %	1993/2 %
1, actively being done	9.2 ~~9.9~~	8.4
2, doing moderately	62.9	56.7
3, doing seldom	23.0	31.9
4, nothing done	3.8	2.1
no answer	1.1	0.9

We can learn some points from the questionnaire :

1) Note Q1. In the 1993's survey, regarding preventive measures, " Individual awareness of safety " came first, the same as in the latest one. Many employees stressed, " Stance of top management " was important in 1993 but in 1997 they pointed out " Exchanging risk information " was valuable.

2) Note Q2. Compared with 1993 anxieties about safety decreased by half in 1997.

3) Regarding the CS Campaign, Q3. to Q5., more than 80 % said they were interested in it.

We have discussed safety issue in the meetings at our workplaces and symposiums for these 10 years to change the mood and circumstances. This has obtained excellent results. However, regarding " evaluation of safety in workplaces " 46.3 % felt, " No change " . This figure indicated our campaign became stereotyped. So, our present homework is how to vitalize this stereotyped CS campaign, co-operating with management.

Secondly, I would like to report another campaign, strenghening bus-body structure. JR East Company owns two subsidiary bus companies whose employees are members of JREU. So, they were challenging to keep safety in their industry along with rail workers. While we were campaigning, a bus driver, who was a member of JREU, was involved in a pile-up accident on a motor way and killed in February 1992. Another driver was also killed by a head-on collision with a two-ton small truck in May 1994. Both buses were so-called " high-decker buses " whose passenger seats are raised but driver's seat is lowered. Just after the later accident occrred JREU demanded of the management not to use this type of bus. We made a claim for strengthening the front structure of the body and the company accepted it at once.
We went to Norway and Sweden to investigate foreign safety measures with managers of bus companies.

As our campaign for bus safety was widely-recognized among people the Ministry of Transport set up a " Bus structure and crew and passengers protection study committee. Of course our vice president, Nara, was elected as a member of the committee.

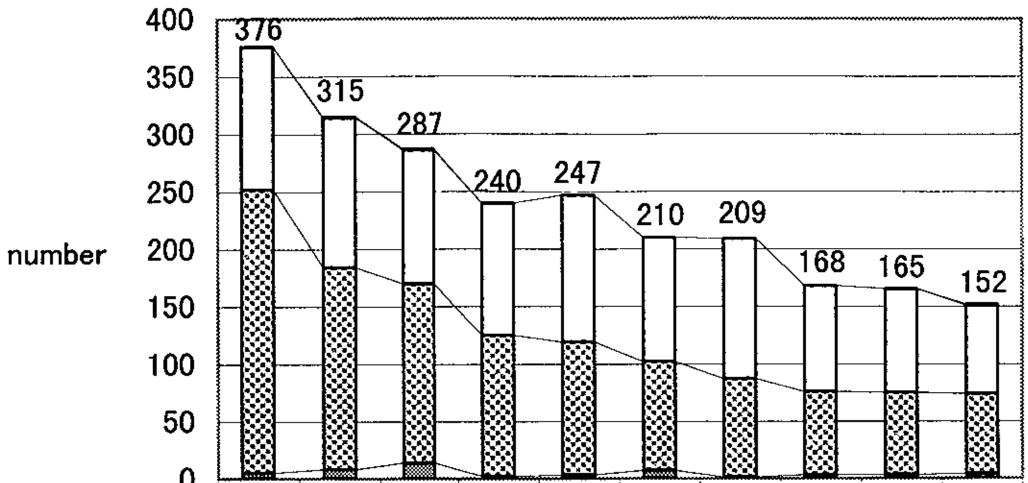
The committee had had several meetings and issued " Short-term safety measures " as an "interim report " in April 1996. It indicated safety measures should be taken in the future. We could greatly improve the safety measures of Japanese buses and coaches that lagged behind internationally. This is one of the successful examples that resulted from learning accidents' cases and measures domestically and internationally.

Next, I will show you actual accident numbers in JR East area for, the latest eight years. The following charts are numbers of operational accidents and level crossing accidents.

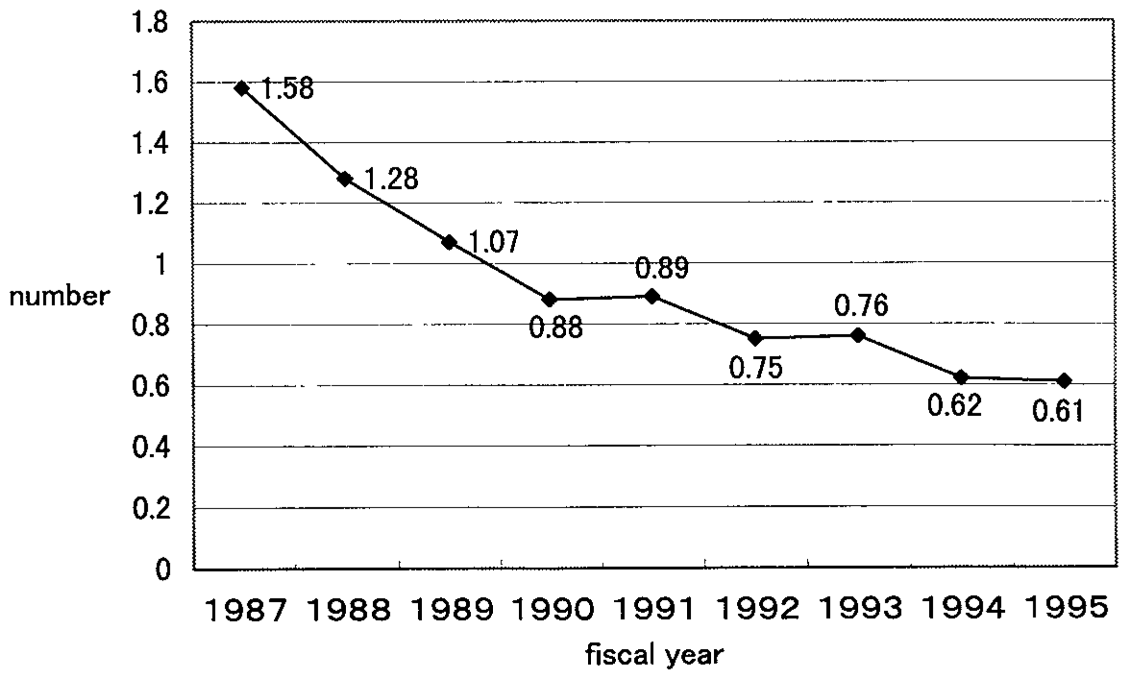
RAILWAY OPERATIONAL ACCIDENTS OCCURRENCE

* Number in 1996 is February to April

Number of operational accident

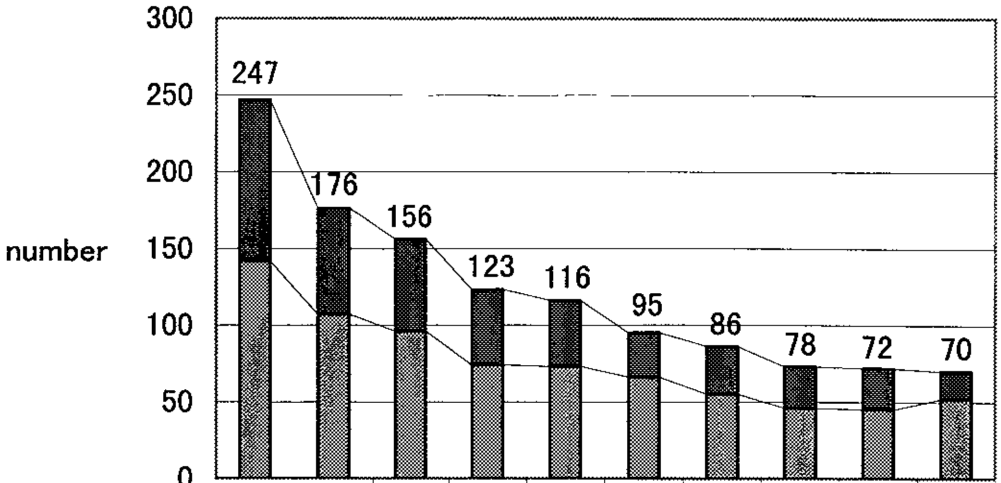


	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
□ others	0	1	1	0	0	0	0	0	0	1
□ injury or death	124	130	116	115	128	108	122	92	90	77
⊠ level crossing	247	176	156	123	116	95	86	73	72	70
▩ operational	5	8	14	2	3	7	1	3	3	4



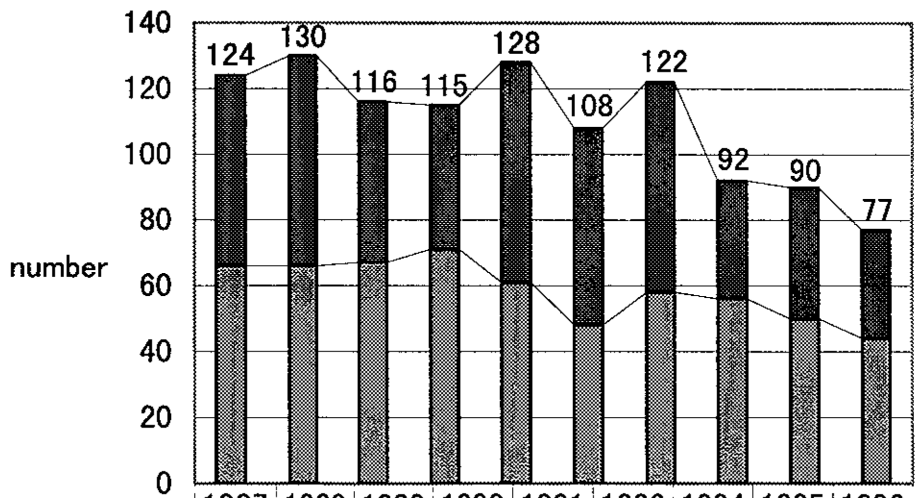
For William Kan

Number of level crossing accidents



	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996
others	105	69	60	49	43	29	31	27	27	18
at crossing	142	107	96	74	73	66	55	46	45	52

Number of injury accidents



	1987	1988	1989	1990	1991	1993	1994	1995	1996
inside rail tracks	58	64	49	44	67	64	36	40	33
fall and hit at platform	66	66	67	71	61	58	56	50	44

Operational and level crossing accidents decreased year by year. Compared with the first year that new JR started, it has greatly decreased. I believe our activities, such as improvement of mood and environment and change of consciousness in workplaces and learning widely from other industries and abroad, produced such good results.

However, we have been faced with another problem. Industrial accidents involving workers work for contracted and sub-contracted companies have not reduced in the last ten years. Of course, they should be responsible for their safety management but JR East company should require preventive measures as well because contracted construction work is done in the same place as train operation. Today we discussed recognition of the present situation, safety management and education in the joint council.

5, Conclusion

Lastly, Recognizing that " Keeping safety is a common problem of union and management ", JREU worked to reform the status quo from the front-line workplaces. The union's tackling of safety issues is based on humanism. Whatever type of system is established eventually, only human, front-line workers can play key roles of keeping safety. The union should have role and responsibility for safety.

Union is required to claim and propose safety measures that are different from management's points of view.

Therefore, I would like to propose that unions and management people concerned with railway safety should attend the next " International Railway Safety Conference " and learn together.

Safety is a common concern between union and management. I would like to appeal that unions and management should work together and talk to each other to promote safety and to develop it for the future.

CORRECTION

UNION'S CHALLENGE TO SAFETY FOR THESE 10 YEARS
by JREU

1, 1p. 51 serious accidents did not occur.
2, 5p,141 1) Accidents eradication declaration . November 1988
3, 5p.23i 5) The 3rd labour and management joint declaration : 1 July 1996
4, 7p. Charts

Q4. What do you think about " Challenge Safety Campaign " ?

Items	1997/2 %	1993/2 %
1, Interested very much	35.0	13.6
2, Interested	45.7	53.9
3, Less interested	16.0	28.6
4, Not interested	2.2	3.5
no answer	1.1	0.3

Q5. Tell the present situation of " Challenge Safety Campaign " in your workplace.

Items	1997/2 %	1993/2 %
1, actively being done	9.2	8.4
2, doing moderately	62.9	56.7
3, doing seldom	23.0	31.9
4, nothing done	3.8	2.1
no answer	1.1	0.9

1997 LUCERNE

21 May - 23 May 1997
Swiss Transport Museum, Lucerne, Switzerland

Paper 9709

Akira Yajima

Tackling Safety Measures in my Workplace

Publisher
2000 International Rail Safety Conference

Schweizerische Bundesbahnen
Chemin de fer fédéraux suisses
Ferrovie federali svizzere
Swiss Federal Railways

INTERNATIONAL RAILWAY SAFETY CONFERENCE (IRSC) 1997
21 to 23 May, Lucerne / Switzerland

PAPER: Safety Management
Takling Safety Measures in my Workplace

PRESENTED BY: Mr. Yajima/ Sekine
Chairman Supervisor's Section

DATE: 21.05.95

SESSION: II

TIME: 1140-1210

INTERNATIONAL RAILWAY SAFETY CONFERENCE 1997
21 TO 23 MAY, LUCERNE / SWITZERLAN

by
AKIRA YAJIMA
Chairman of Foremen organization

TACKLING SAFETY MEASURES IN MY WORKPLACE

1, Introduction

Ten years has passed since the former JNR was privatized in April, 1987. JREU also was formed in 1987 and organized 73 % of all of the employees. As the biggest union in the JR East Company, it has fullfilled its responsibility. The Railway business is a so-called " labour intensive industry ". So, stable industrial relations are very important for management. Since privatization, the business of JR East Company has been successful for these 10 years. This relationship greatly contributed to it.
JREU has regarded that keeping safety is an important factor in railway operation and tackled this issue seriously. Other unions, such as KOKURO, claimed that as a result of privatization, safety would be deteriorated, but it was needlness fear. Union and management could have common recogition that the railway business could not operate without safety, and safety measures are one of the most important issues of management. From such a point of view JREU issued a " Labour and Manegement Joint Declaration " three times in the last ten years and published a " Safety Declaration " in 1994 as well.
However, it is clear that workers in workplaces play key roles for safety. I would like to report tackling safety measures in my workplace.

2, Definition of Safety in the Workplace

A workplace always comes face to face with safety issues. Safety is a situation in which any dangerous or accident factors are removed. Recognizing keeping safety makes our business strong, union and management have introduced up-to-date technology and various safety equipment, and educate workers for safty.
Technological innovation surely improves safety. However, whatever technology will be developed, ultimately human-beings have to carry out safety measures. In order to build a high-safety railway system we should enrich the " hard system" or equipment and the " soft system " or peoples awareness.
Therefore, mood and circumstances in the workplace, such as relationships among people in the workplace and conditions to draw wisdom from workers, are related to

safety. However, in an actual corporate culture that takes priority over safety this could not be establıshed. Union and management did not cooperate with each other well just after the privatization. It is important for managers to manage safety. It is wrong to divide into two sides, people who manage and others who are managed.

It is also wrong that managers " pursue responsbility " and " reinforce tight safety measures " to the workers who were ınvolved in a accident. After all, if some people provide information one–sidedly, the others must feel helpless and do not give their opinions because they are suspicious. Regarding saefty there are so many unclarified things that you need to consult employees in workplaces before you decide. It is essential for labour and management to share imformation and talk to each other. As a result, we can brıng out the wisdom of safety.

We havebeen " challenging safety " from the front lıne of the workplace. We have been tacklıng safety to create a corporate culture in whıch we can talk and advice each other freely.

3, " Challenge Safety Campaign " in the Workplace

(1) Purpose and meaning of " Challenge Safety Campaign "

From September, 1989, under labour and management's agreement, the " Challenge Safety Campaign ", or " CSC ", started. The purpose was to aim to change the safety concept, from " protecting " safety to " challenging " it. The activities were to build a corporate culture that anticipates safety measures through picking up problems from daily work, thinking, discussing and reflecting on the company's safety measures. Facing safety issues at the front line employees began to tackle safety. They set their own safety targets and challenge to realize it.

To sum up :

* As profesionals of our workplace, we define safety issue.
* We make a target that is able to be reachd after the discussion.
* In order to reach this established target, each member does his part.

Valuıng the process, we serıously discussed accident cases and safety measures in the workplace to promote " mood and circumstances " in the front line of our company.

(2) Problems of the Campaign

It sounds excellent when you say " the whole company's campaign " but at first, employees were confused. Top management proposed the campaign and indicated only a simple purpose and there was no concrete manual at all. The notice of the purpose said each employee should challenge to think and practice to keep safety and create new corporate culture.

Only two years had passed since privatization and the bureaucracy inherited from the former JNR, which had continued for a century, stuck in our mind. In the former JNR era unions always confronted the company's policy. Therefore, initiative of employees

and mutual trusting relationship could not be created.
Regarding safety, employees always waited for orders from their superiors and did nothing without obeying rules and regulations. So, we could not tackle CSC until we talked to the management about what we acctually should do.
We needed to clarify the real intention of the management who introduced CSCand what merit employees could get from it. Unless these two points were clarified we could not have had the sense of duty and responsibility to realize the purpose. It ended up " top down " but did not become " bottom up ".
When CSC began, other activities, such as small group activities (QC campaign), were enforced to educate employees and to activate the workplaces. CSC, however, differed from other activities because others produced the results by our efforts but CSC did not produce any results immediately and took time. This campaign depended on our union members' intension.
As safety leaders in the workplace, managers intended to sweep away their passive attitude and they were tested in their position.
The railway business has various kinds of jobareas, such as marketing, operation, and construction and maintenance of tracks, and has colourful jobs, such as the selling and collecting tickets staff, drivers, conductors and foremen. We have such different kinds of jobs that it is very difficult to advance in the same direction. Although all members in the same work unit needed to gather at once, we could not because we have to work over 24 hours. Therefore, it was important that labour and management should share the recognition and leaders of both sides should make an effort to try CSC.

(3) Understanding Purpose and Interest in CSC
I mentioned before that if employees did not understand the real intentions and purpose they could not have had any sense of duty or responsibility, it could not have been created " bottom up " by employees' initiative. At the start of CSC few points were proposed and there was no detailed manual at all. So, many employees in my workplace complained, " Managers burden us with new work load ", " What is CSC ?", " What should I do ? ". Its purpose was too generous for them to underrstand.
Anyway,no manual meant valuing workers' initiative, and we were going to develop safety measures. The managers who supported CSC and union leaders who would play a key role began to discuss how to advance this campaign. At first we started CSC formally. We had meetings and advanced it by trial and error. Although we had to take time, we educated ourselves and it interested us gradually. We recognized that workers in the worksite knew the dangerous hidden places or small and inconspicuous acctivities that would result in keeping safety. Members of the KOKURO union, always against the company, did not cooperate with us despite the fact that the safety issue reflected on them. Today, CSC has spread over all employees but there are some gaps. We are going to promote our consciousness through participating in CSC. We will also

ask further cooperation between labour and management and further efforts by each employee.

(4) Results and Future Problems

I would like to analyize the present situation from several points of view. At first, I am telling about union members' awareness regarding safety and accident prevention.

Through tackling CSC and discussions, each union member has recognized the importance of keeping safety. They said, " It is important to speak my opinions loud and clear " ; " To speak about safety is not only for my sake but also for the others "; " I am happy to give my opinion ".

Next, when tackling CSC there are problems of degree and method. Today, I do not think CSC has became common to the whole workplace. Some other union members do not understand the purpose and they are not interested in CSC. Also some people whose work is not concerned with danger directly are less interested.

However, in many workplaces representatives of union and management and leaders are tackling CSC. They find conditions and method that fit in each workplace. For example, they organize groups to gather easily, use the meetings on duty, or exchange information using a diary or activity notebook.

In the beginning it was difficult for us to fix the theme because we tended to choose the high–level one. We changed our idea and chose easy and friendly themes, relaxing.

As a result, we can enjoy talking and made relaxing circumstances so we can talk to each other frankly. Even a young employee can speak his opinion freely and discuss, regardless of this being between superior and subordinate, and find solution beyond each job's barrier.

Nowadays in workplaces new technology and modernization have been developed and the young generation has been taking over from the elder generation. We have to cope with changing work categories.

Therefore, we need to extend our viewpoint concerning safety. We should review the problems around us. Regarding CSC, naturally, without a mutual trusting rerationship between labour and management and manager and employees we cannot talk frankly.

Managing directors and managers in the workplace are responsible for improving corporate culture. They should draw on what employees think about safety measures and should work together to find solutions through sufficient talk and advice.

As keeping safety is an eternal problem we should continue CSC and deepen it, but we should overcome the mood of sterotyped actions and stagnation. We should renew further the corporate culture so that all employee can speak clearly about safety. We also ask to build the system and organization to listen to opinions from workplaces and to reflect them properly in safety measures. Management needs tosupport them.

JREU pointed out that workers in workplace have wisdom to prevent accidents. Union and company have shared the recognition of safety. Uunion and management in the workplace need to discuss. This common recognition has supported CSC. As a result, a corporate culture that put priority on safety was created, safety conciousness of employees was greatly promoted and safety of service and workers surely improved clearly.

5, From Pursuing Resposibility to Investigating Causes

Furthermore, through CSC and participating International Railway Safety Conferences we changed our concept, from pursuing personal responsbility for error or accident to investigating causes. When we started CSC we could not talk about the facts of accident cases frankly because management's stance toward operation errors or accidents was a problem. They pursued responsibility when the worker was involved in accidents. It was said " error equals penalty ". This management's attitude deteriorated the relationship between labour and management. It also badly affected communication between managers and union members in the workplace.

The purpose of CSC is to discuss and investigate causes of errors or accidents but not to pursue the resposibility. Especially, safety is often affected by human relations. If you do not trust others you would say nothing helplessly and the real problem would be concealed. We need to create a proper " Ba " or " Place " where we can talk frankly and seriously to aim at tackling safety issue.

Until you recognize causes corectry you cannot create effective accident preventive measures. In order to investigate the background of causes it is essential for the investigator to cooperate with people who were related to accidents. Only joint investigation between investigators and those who were involved in the accident will make the causes clear.

We changed our concept, to investigating causes through frank discussion, mainly by the CSC which contributed to this change. It produced the fruitful result that communication between managers and union members in the workplace became frequent. However, the change of corporate culture " from pursuing resposbility to investigating causes " does not mean we do not pursue responsbility of those who were concerned. We want to cut the short circuit, such as " error equals penalty ".

6, Further Challenge to Safety

JR East Company operates 12,000 trains per a day and the number of passenger is approximately 16 million per a day. We take care of 16 million passengers' lives and time and take them to their destination safely.

Therefore, we regard keeping safety as the basic of railway operation and work to create a safe railway that passengers can use at ease. Each member of our union has intended to keep safety and JREU has asked to build a high-grade safe railwaysystem and to invest in safety equipment and facilities. As a result, the number of train operation accidents has decreased dramatically for the last ten years.

" Safety Basic Scheme " decided in 1994 has five main points :

1) To provide the safety equipment and facilities,

2) To create circumstances that employee can develop their faculties and work positively,

3) To manage an organization to control safety properly,

4) To create a system in which managers in the workplace can lead safety measures,

5) To cope with changes of circumastances, such as technological innovation.

Even through technology develops, there will be no perfect equipment to prevent accidents. Ultimately, human-beings play a key role to the complement technological system. Keeping railway safety can be achieved by the combination of responsible work done by each employee.

Railways should be safe and reliable and this marketable value should be promoted. Without challenging constantly we cannot keep safety of passengers and trains. This is an obligation shared equally by labour and management.

From the union's viewpoint our main tasks are to secure members' jobs and to improve working conditions. However, we have premise that the company should develop and be healthy. Accidents could shake the basis of company finances. We have provided the safer service for last years through the discussion between labour and management in workplaces. We recognized that union and management should continued to tackle safety issues as far as the company exsists.

I stress that cooperation between labour and management is essential for keeping safety, with my workplace as an example.

1997 LUCERNE

21 May - 23 May 1997
Swiss Transport Museum, Lucerne, Switzerland

Paper 9710

Oliver Cremien

Consideration of Traumatic Factors and their Treatment in Jobs involving Safety-related Tasks

Publisher
2000 International Rail Safety Conference

Schweizerische Bundesbahnen
Chemin de fer fédéraux suisses
Ferrovie federali svizzere
Swiss Federal Railways

INTERNATIONAL RAILWAY SAFETY CONFERENCE (IRSC) 1997
21 to 23 May, Lucerne / Switzerland

PAPER:	**Human Factor** **Consideration of Traumatic Factors and their Treatment in Jobs involving Safety-related Tasks**
PRESENTED BY:	**Mr. Olivier Cremien** **Psychologist**
DATE:	**21.05.97**
SESSION:	**III**
TIME:	**1400-1430**

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SNCF
DIRECTION DES RESSOURCES HUMAINES

TITLE : CONSIDERATION OF TRAUMATIC FACTORS AND THEIR TREATMENT IN JOBS INVOLVING SAFETY-RELATED TASKS

THEME E : CHEMIN DE FER ET ENVIRONNEMENT

Text for the IRSC Congres - Lucerne - 1997.

Author : Olivier CREMIEN

Key words : PREVENTION, PSYCHOLOGICAL SUPPORT, TRAINING, ASSAULT, ACCIDENT.

To perform tasks related to safety, be it their own safety, those of colleagues or those of customers, SNCF staff must satisfy certain physiological, intellectual and behavioural requirements which will vary according to the post they hold. To this end, the company's team of medical staff and industrial psychologists carry out a selection. Staff that are selected then go through a training process that is sanctioned by a final examination and receive supportive monitoring, covering all the functions associated with the job in question. Throughout the career of staff, the medical services monitor their progress on a preventative basis in order to confirm their safety aptitude. It is then the task of managerial staff to detect those operators that encounter difficulties in applying the safety procedures. The psychologists may meet the operator again to conduct a reassessment of his/her compatibility with the post held. To this end, regular meetings are held between all the parties concerned in order to monitor progress and introduce flanking measures tailored to the individual in question.

When these work groups began, it fast became apparent that there was one hitherto little known area for which no procedure had been put in place: this concerned the psychological and physiological repercussions that an accident (with human injury) or an assault can have on a person's behaviour on the job. This includes, for example, difficulty in paying attention, in concentrating, or recurrent memories returning at any moment and can go as far as a gradual slide into neurosis or some other form of pathology.

One serious safety error committed by a person who had just experienced considerable stress when the train he was driving "hit" a passenger in the platform area brought the whole company face to face with the question of traumatic events and their repercussions. This situation, which was considered an exceptional circumstance in impact terms, was finally acknowledged as forming an integral part of the job, since two out of three drivers are confronted with it in the course of their career. For several years now, psychologists have been working to heighten the awareness of all the company workforce to such issues and have proposed a series of initiatives at three levels:

- ☞ prevention,
- ☞ psychological support,
- ☞ training of safety managers.

1 - PREVENTION

This involved the inclusion of a "psychological preparation" day in the initial training programme for driving staff. The aim was to inform staff without alarming them about this "risk of the job" and its possible repercussions at behavioural level in the short and medium term. The concern above all was to reassure them by describing the kind of reactions they were likely to have and explain the causes using suitable psychological methods. The need to express and release the emotion linked to the event through talking is a particular point of emphasis. Through this initiative, drivers that are exposed to accidents or assaults are able to express what they have experienced and felt and this can help them to ask for the appropriate psychological support. Hence the creation of a victim help centre.

2 - PSYCHOLOGICAL SUPPORT

A 'phone line has been set up for staff who feel the need to talk about what they have just experienced. They are put through to a psychologist trained to handle this kind of situation at any time. It is known that the faster the victims are able to release their emotions, the less they run the risk of showing post-traumatic symptoms. Staff can then have access to 3 psychological support interviews, either individually or in groups. These interviews take place during working hours and are fully confidential. Group interviews may be held when several persons have been faced with the same event.

3 - TRAINING OF SAFETY MANAGERS

The hierarchical superiors of the staff member concerned have an important role to play, firstly in terms of immediate support, attentive listening and administrative monitoring and secondly in terms of the acknowledgement of suffering. The victim needs to feel acknowledged by those around him and freed from feelings of guilt without for all that being "mothered". It should be emphasised that many managers in such cases were at a loss what to do and felt uncomfortable. Some had indeed been victims themselves at one point or other in their career and now found themselves confronted with the same painful event, which interfered with the way they related to the operator in question, leading to rejection of the individual or to excessive support, a lack of neutrality and knowledge of the manner in which the suffering found expression. The aim of this training is therefore to enable managers to be more at ease in approaching this situation and to address the traumatic situation in an interview in which suitable assistance can be offered to the operator. The training lasts two days (in succession) and involves exercises in the form of presentations and simulations based on actual experiences.

International Rail Safety Conference

1997 LUCERNE

21 May - 23 May 1997
Swiss Transport Museum, Lucerne, Switzerland

Paper 9711

Jos Hendriks

Learning from Incidents: Control the Controllable

Publisher
2000 International Rail Safety Conference

Schweizerische Bundesbahnen
Chemins de fer fédéraux suisses
Ferrovie federali svizzere
Swiss Federal Railways

INTERNATIONAL RAILWAY SAFETY CONFERENCE (IRSC) 1997
21 to 23 May, Lucerne / Switzerland

PAPER: Human Factor
Learning from Incidents: control the controllable

PRESENTED BY: Mr. Jos Hendriks
Staffmember Railway Safety

DATE: 21.05.97

SESSION: III

TIME: 1430-1500

Curriculum Vitea

Jos Hendriks

Electrical Engineer

1970-1987
Various positions in management and project management in the Infrastructure Division of the Netherlands Railways (NS) (research, design and installation in the field of telecommunications- and train control-systems)

1987-1994
Head of Railway Safety Department, Operations Division NS

1994-1997
Deputy head of Railway Safety Department Railned.
Safety Policy advisor.
Currently employed in Risk Assessment, Risk Analysis new infrastructure, development accident-investigation and safety-audit tools.

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Learning from incidents:

control the controllable

Colophon

Ing. Jos P.J. Hendriks

International Railway Safety Conference
May 21-23 1997
Luzern, Switzerland

Contents

1 Introduction

1.1 Rail transport in the Netherlands

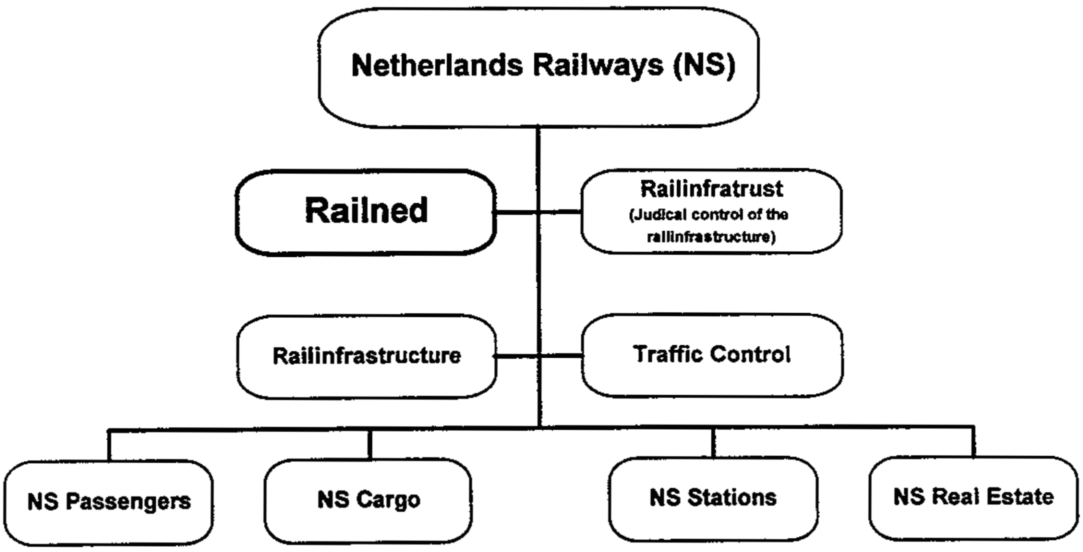
In 1993 the Dutch government agreed to separate the management of the infrastructure and the commercial exploitation as indicated in the EC-guideline 91/440. This separation was officially established in 1994.

The central government is gradually cutting back on its subsidies to Netherlands Railways (NS). There is still a great deal of discussion in the Dutch parliament about the claims of the NS on the main-line network, and about when and how competition is to be introduced on this network. In the NS's opinion, unremunerative lines should be paid for by the central or local authorities, to be stipulated in the form of contracts, when the financial aid ceases in 1998. It will then no longer be a matter of course that the NS provide the rail transport. Meanwhile, a great many candidates have already applied to the central government. This resulted in the exploitation of a passenger service from Amsterdam to the coast in North Holland as from August 1996, the first competitor on the railway network. This line had been shut down by the NS in 1983.

1.2 Organisation of the Netherlands Railways (NS)

The organisation of the NS was drastically changed in 1994: a separation into a commercial sector and a task sector. The task sector is financed by the central government and carries out tasks for that same central government.

Organisation chart NS



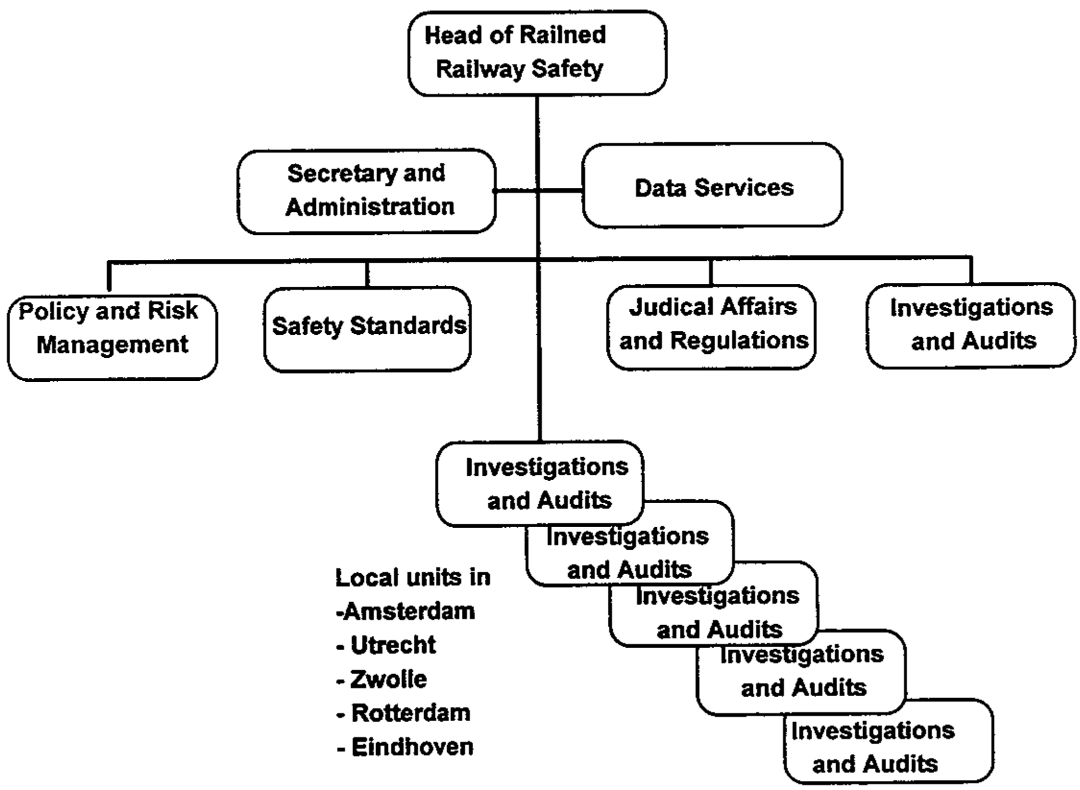
The task sector consists of three departments:

- *Railinfrastructure management*
  The tasks include construction and maintenance of the Dutch Railway infrastructure
- *Traffic Control*
  The tasks include the short-term allocation of the infrastructure and the responsibility that traffic is controlled safely
- *Railned*
  Organisation for capacity management (Capacity allocation and Development of new infrastructure) and Railway Safety

1.3 Tasks Railned Railway Safety

- policy-making, formulating regulations and specifications in the field of Railway Safety
- advising the Minister of Transport, Public Works and Water Management on matters concerning railway safety and legislation
- formulating safety regulations
- carrying out risk-analyses and drawing up integral safety plans for new infrastructure, new processes and new techniques
- carrying out inspections and audits
- carrying out investigations into accidents and incidents
- testing whether new participants in the rail transport system meet the requirements concerning expertise, organisation and ensuring safety
- certification of stock-maintenance companies, "arbo"-services (concerned with working conditions as specified in the Factories Act) and examination institutions

Organisation chart Railned Railway Safety



1.4 Key figures of the Netherlands and the NS 1996

the Netherlands:
- population: 15.5 million
- inhabitants per km^2: 456
- passengers per year public transport:
    - bus/tram/underground railway: 710 million
    - railway: 315 million
    - *air traffic: 25.3 million*
- number of cars: 6 million

Netherlands Railways (NS):
- personnel: 28,000
- passenger-kilometres: 14.1 thousands of millions
- passenger train-kilometres:110 million
- kilometre tonnage: 3.1 million
- length of network: 2,795 km
- of which 1991 km is electrified
- Automatic Train Control: 80%
- passengers per day: 900,000
- trains per day: 4,500

1.5 Investigations into accidents and incidents

All accidents and incidents related to railway safety are investigated by Railned Railway Safety. Approximately 450 investigations take place each year. The reports are sent to the Minister of Transport, Public Works and Water Management. There is little criticism on the quality of the reports. Even so, Railned Railway Safety itself is not entirely satisfied with the investigations. Compared to Railned Railway Safety's other activities, these investigations take up too much time. The completion time is often long and the implementation of the large numbers of recommendations is often an uphill battle. In a company that feels very strongly about quality, there must always be the question of whether it can improve the quality of its products/services.

Which is why a research method was developed in co-operation with the University of Leiden in the Netherlands (Prof. Wagenaar, Dr. Groeneweg) which is more in keeping with Railned Railway Safety's wishes. The TRIPOD-philosophy constitutes the essence of the new procedure. The method was put into use at the beginning of 1997 after all of the researchers had received training. The method is to be further developed as a safety-audit instrument in 1997/1998, which will make it easy to compare the results of accident investigations with those of the audits.

2 Why improve accident investigations?

2.1 The old method of working

Before the separation of the management of the infrastructure and the commercial organisations in accordance with the EC-guideline 91/440, investigations into accidents and incidents were carried out by the Traffic Operating Department. Railned Railway Safety was charged with these investigations in 1994, in order to guarantee the independence of the accident investigations. Investigations into accidents and incidents are categorised into four groups. The categorisation is based on the risk involved (chance of suffering injury or damage) in the incident/accident in question. Negative publicity and damage to the company's image are factors that are considered as well. The incidents in categories I, II and III are investigated by Railned, category IV incidents are investigated by the business unit most involved in the incident.

- *Category I (approx. 5 per year):*
    * very serious accident;
    * casualties and injuries among passengers, personnel, people living in the neighbourhood and/or
    * extensive material damage (> 5 million Dutch guilders) or damage to the environment and/or
    * very great potential risk for passengers, personnel, people living in the neighbourhood, the environment;
    * investigation is led by the Head of Railned Railway Safety;
    * reports to the Minister of Transport, Public Works and Water Management, the Railway Accident Board and the Railway Inspectorate.
- *Category II (approx. 40 per year):*
    * safety of the rail transport and/or persons is seriously threatened;
    * more than minor injury to passengers, personnel, people living in the neighbourhood;
    * heavy damage (> 1 million Dutch guilders);
    * investigation is led by non-involved manager or expert from one of the companies, selected by Railned Railway Safety from a supply of approx. 40 directors of research;
    * approval from the Head of Railway Safety;
    * reports to the Minister of Transport, Public Works and Water Management, the Railway Accident Board and the Railway Inspectorate.
- *Category III (approx. 400 per year):*
    * safety of rail transport or persons has been jeopardised;
    * minor injury;
    * damage in excess of 0.1 million Dutch guilders;
    * investigation is led by the Head of the Regional Unit Railned Railway Safety;
    * approval from the Head of Railway Safety;
    * reports to Railway Inspectorate.
- *Category IV (approx. 2000 per year):*
    * incidents with limited risks;
    * investigation led and conducted by business unit involved;
    * approval from the management of the business unit;

* reports to Railned Railway Safety.

The investigation is conducted by the staff of the Regional Unit Railned Railway Safety where the accident or incident took place. Where it concerns accidents on a larger scale, the Railned researcher will immediately go to the sight of the accident to secure factual material. Until the Railned researcher arrives, the head of calamity control has the additional responsibility of taking any measures necessary to ensure the safety of research material. The railway staff involved, such as the drivers and movements inspectors, is questioned by their own management or by the railway police. The results are recorded in a statement and are made available to the researcher from Railned. If necessary, the Railned researcher will conduct an additional interview. An initial analysis is made based on the collected data, statements and interviews. It is sometimes necessary to conduct specialist research. This research is contracted out to authorities who are specialised to do so. The analysis is made using a method that is based on the Ishikawa diagrams. The method entails a systematic assessment of the direct causes in terms of means, methods, people and the environment. After that, the underlying causes are examined.

On completion of the causes-analysis, recommendations are formulated in order to prevent the accident/incident from happening again in the future. These recommendations are then assessed with respect to the costs and the risk reduction.

The draft report is discussed with the railway staff involved and the management in a so-called safety meeting. It is decided by whom and when the recommendations are to be implemented. The report is then finalised.

After the report has been approved, the recommendations are implemented in a database for monitoring purposes, and the research data is implemented in an accidents/incidents database so it can be used for risk-analyses. This database contains all of the reports that have been made since 1-1-1981.

2.2 Problems

The method and procedures employed resulted in investigations of a reasonable quality and in many recommendations for preventing a recurrence. Even so, there were reasons to adjust the research method and the procedures:

- *The time elapsing between the incident/accident itself and the final report (completion time) is too long.*
  The procedure was by no means accomplished within the designated standard of 100 days. The average completion time came to 190 days.
- *Too much time was spent on each investigation. One must consider whether the efforts are worth what is accomplished in terms of safety.*
  Because approx. 65% of the capacity of the Regional Units is utilised for investigations, too little time remains for audits and inspections. There should be a better distribution of the available time between investigations, audits and inspections.
- *There are a great many recommendations.*
  Many of the recommendations take too much time to implement. A lot of the recommendations are not implemented at all, or they are "outrun" by new recommendations. Monitoring requires a lot of effort, and so there is often little motivation for its implementation.
- *The research results are strongly influenced by the background, experience and creativity of the researchers.*

- *Improvements often focus on the railway staff involved.*
  Approximately half of the recommendations concern education, revision exercises and the motivation of the railway staff involved.
- *It is difficult to compare the results of accident investigations with the results of audits and inspections.*
  There is a need for a set of instruments which are all based on the same philosophy on safety and methods, so that the results can be compared and may confirm each other.
- *It is often difficult to justify drastic or costly recommendations on the basis of one single incident.*
- *The investigations cost a great deal of time, even if the researcher knows in advance that the results in terms of safety will be limited.*
  Safety investigations are often similar to audits in many ways. How in-depth and broadly-based the investigation will be, largely depends upon the researcher. There is a strong inclination to include as much as possible in the investigation.
  Many efforts are made to find out the truth. The researchers are of the opinion that, if one is to improve safety, it is important to determine the truth.

3 New method: SAMOS

A new method has been developed in co-operation with Prof. Wagenaar and Dr. Groeneweg from the University of Leiden, which is based on the so-called TRIPOD-approach. This approach departs from the concept that there are 11 problem areas in organisations which are the basic causes of all incidents. These 11 so-called General Failure Types (GFT's) are factors which can be controlled by the management. The development began on 1-1-1996 and lasted one year. A number of pilot studies were carried out by Regional Units during this time as a means of testing the methodology in practice. In addition, the method was used for a further analysis of approx. 50 older investigations in order to determine the added dimension of the new method compared to the old method. All of the researchers received training at the end of 1996, and the new method, which was given the name SAMOS, was put to use at the beginning of 1997. Following the complete implementation of SAMOS for accident investigations, the method is to be further developed as a means to carry out safety audits. SAMOS is the Dutch abbreviation for `Spoorwegveiligheids Audit Methodiek en Onderzoeks Systeem' (= Railway Safety Audit Methodology and Accident Analysis System). The audit-method is scheduled to be completed mid-1998.

A detailed description of the underlying philosophy, method and procedure is given in the appendix: SAMOS, the background to the method.

3.1 Changes in the method of working

The introduction of SAMOS has led to a number of changes. The most important changes are listed below:

- *An investigation always starts with the railway staff involved.*
  They are usually the only ones who know what went wrong and particularly which circumstances prevailed at the time. It is no longer required that one wait for the statements taken by the management or the railway police, the railway staff involved is interviewed by the researchers within a period of 5 days (max.). The 11 GFT's function as a guideline when conducting these interviews. The persons involved have filled out a simplified list stating the 11 GFT's beforehand. The answers serve as points of departure in the investigation.

- *Only investigate what needs to be investigated.*
  If the interviews reveal that there were no controllable factors (GFT's) involved, the investigation is to be concluded with a so-called "oops"-report as soon as possible. This is a simple form of reporting, which does include recording the data that is to be entered in the accident-database for use in analyses at a later time.
- *Not investigating any longer than necessary.*
  It is more important to detect controllable factors (GFT's), than to try to discover the truth at any cost. Sometimes the statements of, for example, the driver and the travelling ticket inspector, are contradictory. Trying to get them to agree will often be very time-consuming, whereas this is not really relevant as far as improving safety is concerned.
- *The researcher has less influence in the research*
  The method allows the researcher less liberties. The researcher is obliged to work according to a certain pattern and to focus attention on all relevant subjects.
- *The completion time is reduced.*
  The first results show a reduction in the average completion time. The goal is to realise a standard of 100 days on average.
- *Number of measures is decreasing, quality of measures is increasing.*
  The number of measures is decreasing, and so they are easier to implement. If no GFT's are found, improvement is not possible. Good research does not necessarily have to result in more recommendations. The GFT's that are found are often not enough to justify severe measures on the basis of one single incident. Which is why the causes that are found are 'stacked' in the form of GFT's for the purpose of analysis at a later time.
- *Multiple incidents analysis can easily be carried out.*
  Almost every investigation will reveal one or more controllable factors that can be categorised in GFT's. After that, it is possible to gain insight into the entire railway traffic system, per company and per department. This can then be used to begin specific improvement campaigns and to compare companies, and will allow for trends to be discovered more easily.

3.2 Conditions for success

A number of conditions must be fulfilled if the method is to be a success:

- *Communication.*
  Good communication between the railway staff, the management and the recipient of the reports is important. It is important that one understands why attention is initially focused on the interviews with those involved before the management is involved, and it must be understood that a "no blame culture" is a prerequisite for success.
  The railway staff has been informed via the "safety newspaper". Regional meetings were held for the primary and secondary management and a separate briefing took place for the "top-100".
- *Education.*
  All of the researchers should receive ample training in using the method, with special attention for real-life cases. There should be only a short time between receiving training and actually employing the method. All 20 researchers were trained in three weeks time. A start was made with the new method two weeks later.
- *Support.*
  Sufficient support is essential at first. It should be possible to discuss any problems which may occur in practice right away.
  This has been achieved by setting up a central "help-desk". If necessary, the problem can be discussed and solved on location.

- *Manual.*
  It is very important to record the methodology and the procedures. The procedures and method of working have been set up in such a way that they comply with ISO 9001. An ISO-audit, to take place mid-1997, will determine whether the method is in accordance with the ISO 9001 standards.
- *Education third parties.*
  Category IV investigations are not carried out by Railned, but by the companies involved. In order to have these investigations be more in keeping with the Railned-procedures, a training course will be developed and offered to these companies.

4 Conclusions

The new method has been in use for too short a time to be able to draw any concrete conclusions. However, the results indicate that the most important aim, "control the controllable", will be reached. The first conclusions are:

- The average completion time is decreasing.
- A reduction in the capacity that is utilised for each investigation has yet to be realised. This can be partly explained by the fact that the researchers still have to gain experience and that they frequently spend time explaining procedures to others. In addition, the interviews have been found to be time-consuming;
- The railway staff and the management involved are usually very enthusiastic about the new approach, particularly its direct and personal character.
- The quality of the investigations has improved. Though it is true that the structured method results in less liberties for the researchers, the method provides more points of view which were never dealt with in the past.
- Good communications with the companies involved has proved to be essential.
- The number of recommendations has decreased, the quality of the recommendations has improved. Evaluation of the implementation (monitoring) has yet to occur.
- A start will be made with the development of the audit-instrument mid-1997.

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LEARNING FROM INCIDENTS

to

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Appendix

SAMOS

Backgrounds of the method

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9 april 1997

The Quality system of Railned Railway Safety Head Quarters is certified according to
***EN-ISO 9001 1994** under DNV-number CERT-00159-97-AQ-ROT-RvA*

Contents

1 Introduction

1.1 The traditional policy on safety

The number of accidents in and around the railway system has already sharply declined by comparison with a few decades ago. Technical improvements and security devices, adjusting the equipment to human strengths and weaknesses, better working conditions, an increased average level of education of the employees and focusing more attention on safety aspects have contributed greatly to this higher level of safety.

However, as any accident is one too many, it is appropriate that the railway continues to pursue a greater degree of safety for its passengers and a safer place to work for its employees. In addition to reasons of a humanitarian nature, there are also economic reasons for a company to pursue an effective policy on safety: a safe company is believed to be an economically sound company as well. The number of accidents and incidents could be a measure for how efficiently a company is operating and for the quality of the management in general.

Analyses of accidents show both technical and human errors. Several studies have been done to estimate the relative contribution of human error to accidents.In the industrial sector, this proportion varied from between 50 and 90% of all of the contributing factors. In the railway sector, the proportion of human error is probably on the upper side of this interval. One study (Wittenberg, 1978) revealed a proportion of 96%! We have seen many, mainly technical, improvements in the railway system in the past decades; and so the time has come to tackle the human factor in the accident process. This human factor was traditionally dealt with as follows: the person(s) involved were given a firm dressing down or were even dismissed after an accident. The general view of man's part in such matters was quite simple: the person was seen as: stupid, thoughtless, inattentive, insufficiently motivated, he or she took irresponsible risks and lacked any `safety awareness'. Indeed, dealing with the staff in this manner seemed to be successful: sure enough, after a good talk he or she was usually not involved in an accident for a long time to come. The fact that this was a matter of statistics often went unnoticed. In most cases someone else then became the victim of the unchanged and dangerous situation. These opinions on controlling the human factor in the accident process are in close keeping with what `laymen' believe psychologists can do to increase safety in the company. Hired psychologists, pre-eminent authorities on the human mind, are expected to propose suitable measures which will increase the employee's 'motivation' or 'safety awareness'. Chapter 2 will explain why we can expect only limited results from such measures.

1.2 Problems involved in measuring safety

In order to be able to take effective measures, the manager must first have a clear understanding of the problems which may occur in the company. Well-executed accident analyses can provide the greater part of this understanding, provided that the number of accidents is large enough to allow one to obtain a reliable picture of the risks. In addition to this, near-accidents can provide the necessary information as well. Essentially, these near-accidents do not differ from actual accidents: they contain the same ingredients, only the final result is different. In most cases, the person(s) involved just got lucky.

If an accident occurs, the circumstances surrounding the accident are carefully examined. So-called event trees are often used in these investigations. The factors contributing to an accident are arranged and structured in a logically sound and surveyable manner. Analyses show the circumstances surrounding accidents to be so complex, and the concurrence of circumstances to sometimes be so unfortunate, that these accidents could be considered `impossible'.
In the conclusion of an accident analysis, the course of events seems logical and predictable. It is however a misconception to think that the persons involved should have been aware of the fact that an accident threatened to occur. Knowing the outcome of a certain series of actions influences one's opinion on whether or not the outcome could have been predicted ahead of time. In retrospect, everything seems to inevitably lead to the accident occurring. However, the persons involved in the accident process were not in the least aware of the approaching accident, nor did they consider it predictable. Each had only part of the necessary information and the effects of some actions did not become known until much later. The operations that were carried out had often been performed for years without ever having caused an accident. The fact that the situation in this particular case was slightly different compared to previous situations was almost or completely unobservable to the persons involved. In order to successfully prevent accidents from happening in the future, it is essential to realise that it is impossible for the persons involved to gain a full understanding of the situation they are in, and that they are scarcely capable of anticipating the consequences of their actions. For that reason, we shouldn't rely too much on the persons involved being able to correct their actions on time.

Because so many factors contribute to an accident, every accident is always unique in some respects. Drawing up long lists of the details of a series of accidents will not provide an understanding of the most important problems, nor will it reveal if the company is making headway with the aspect of safety. It is however possible to logically divide, for example, human errors into classes, so that one can gain a better understanding of the causes which lay at the root of accidents. (One such classification system for human errors is that of Feggetter (1982). Studies of the police organisation, the shipping industry and a large oil company, in which the errors were classified according to Feggetter's checklist, revealed the most important category of human errors to be that a wrong hypothesis was followed. The persons involved believed themselves to be in a different situation than was actually the case, and so they took the wrong measures.)

However, as far as preventing accidents is concerned, such an error classification approach offers but little prospects. Simply classifying human failures into types will make the data more surveyable to be sure, but it is not enough to result in effective control measures. The failures must be traced back to underlying factors that can be controlled by the management. And so, when measuring safety, it is necessary to employ a system that measures how these structural, organisational factors contributed to the accident. For this purpose, Railned, in co-operation with the University of Leiden, developed SAMOS (SpoorwegVeiligheids Auditing Methode en Ongevalsanalyse Systematiek = Railway Safety Auditing Method and Accident Analysis System).
The method has been employed in the safety inspection since February 1997; an accompanying audit -instrument is still being developed. Because of the common basis, the data from the accident analyses and the audits can be combined.

We will now discuss the various types of human failure which can be distinguished. Then we will indicate possible ways to prevent these types of failure from occurring. Finally, we will present the SAMOS- approach to accident prevention.

2 Human failure

2.1 Introduction

It becomes clear on studying accidents that the term 'human failure' is too general: the diversity of errors which people make is enormous. There is an essential dissimilarity between someone who fails to observe a signal, a Belgian in the Netherlands who is looking for a signal on the wrong side of the track, someone who allows a train to depart under iced-over conditions because he/she believes the situation is controllable, and someone who runs a train at 160 kilometres an hour on a track where the maximum speed should not exceed 80 kilometres, just to make up for lost time. The first two cases concern an *unintentional* action with an *undesired* result. In the case of allowing the train to depart under iced-over conditions, the situation is different: allowing the train to depart was a conscious decision. Unfortunately for the driver, the decision was not very appropriate considering the local circumstances. Finally, in the case of the speeder, the behaviour was not only *conscious,* but the outcome was *planned* as well.

2.2 Various types of human failures

The distinction between conscious and unconscious undesired behaviour is important when determining which measures to take to prevent this behaviour from occurring in the future. Roughly, one can distinguish between three types of behaviour when assessing *human errors:*

- Unintentional actions:
  - Slips ('Oopses');
  - Lapses;
- Intentional actions:
  - Mistakes;
  - *Violations:*
    - Routine;
    - Once-only;
    - Sabotage.

1. *'Slips'* are unintentional (unconsciously performed) actions which lead to an undesired effect. An example is pouring coffee into the sugar bowl instead of into the cup. A *'Lapse'* is showing negligence when performing necessary actions, such as switching on the coffee-maker without having put any coffee in the filter.
The incorrect actions in this category mainly occur while carrying out tasks which are done on a regular basis. That is, operations which are more or less performed on automatic pilot, without considering any factors such as risk and danger. And so it is possible to prevent many of these mistakes by freeing these tasks of their routine nature. However, this could involve certain disadvantages: ensuring that certain tasks are no longer performed by persons very skilled in doing so, or that employees are constantly interrupted while performing a task so that a series of routine operations is no longer routine, would require an extensive control and influence system within the organisation. In addition, one must consider the fact that people are only capable of carrying out certain complex tasks, because they perform certain operations or parts of an operation without really thinking about it. Driving a train while simultaneously operating the walkie-talkie is only possible if many of the

processes involved in driving a train have become an `automatism' due to many years of practice and experience.
Some of the unintentional actions can scarcely be prevented, if they can be prevented at all. No one can stay fully alert for 8 hours straight: after a while one's thoughts will irrevocably wander off. This process cannot be influenced, it is 'the nature of the beast'. Furthermore, people respond to motions and loud noises by looking at them. This unconscious reflex may have negative consequences if the person in question should have been looking at something else at the time.

2. A different category of incorrect actions concerns consciously performing a certain action believed to be correct in view of the situation at hand. However, the situation as one perceives it does not always correspond to reality. Misjudging the situation is a frequently seen cause of accidents occurring. Though the scenario is different from what one believes it to be, one still acts accordingly. Any information that is not in keeping with the scenario often goes unnoticed, or is quickly disregarded. The best known example might very well be the accident which occurred at the nuclear power station on Three Mile Island, at which time the very experienced and skilled operators of the plant misinterpreted the available information and then did precisely what was needed to make the situation even more dangerous instead of doing what was necessary to regain control of the situation.
This type of consciously performed actions which lead to undesired results are called *'mistakes'*.

3. The final category of incorrect actions concerns consciously committing a violation by ignoring regulations or rules. These consciously performed unpermitted actions are called *'violations'*. Because people are inclined to establish their own priorities, they constantly break all kinds of rules for a variety of reasons. However, the rules themselves may be flimsy, for example because they interfere too much with the progress of the operations. The occurrence of a 'work-to-rule strike' is an illustrative example in this context. Meticulously complying with all of the rules can be just as effective in paralysing the railway as an actual strike can.
The rules may also be so complex or extensive that the users are no longer clear on which rules to apply in a certain situation. Some rules limit the personal freedom of people in a certain area to such an extreme, that a violation of these rules is not only provoked, but should only be applauded as well. The attitude towards those who break the rules is often ambiguous: if the violation has a positive influence on the company, the offender is often praised. Many important things have been invented because people consciously try to go beyond the limits of what is permitted. If the effect of the violation on the company turns out to be negative, it will be pointed out to the offender that certain rules exist and for good reason, and not infrequently the person concerned will be punished.

A lot of the traditional safety campaigns focus on preventing violations and not on eliminating errors and mistakes. However, deliberate violations constitute only a minority of the causes of accidents in the work situation itself, even though they are often most prominently put forward in accident reports. The majority of errors in the work situation are unintentional actions or mistakes. Hanging up posters and warnings will have but a very limited effect, because people are not aware of the errors they make. In the boardroom on the other hand, 'slips' or 'lapses' scarcely ever occur, after all, the tasks which managers perform whenever they make an important decision are not routine tasks. And if any errors are made, these usually concern either mistakes or violations.
Fortunately, the mistakes often have little or no effect. Because the top-manager of a company is well-protected, and because any decisions which are made are often evaluated by a number of other people, any errors that are made will not lead to incorrect policy measures. In the case of a resolute violation of standards or rules, this protective shield is

less available. The hierarchy which prevails in a company often makes it difficult to bring a manager into line when he or she stands on one's dignity and `takes full responsibility', even if it is clear that a wrong decision is being made.
So even if one were to attempt to increase safety by applying more stringent rules or hanging up warning signs and posters in order to prevent deliberate violations, these would be less out of place in the boardroom than on the shop floor.

3 Prevention of human failure

In addition to a technical factor, every accident or (environmental) incident almost always involves man as well. It is only natural to want to deal with this human factor. The question however is where to concentrate our efforts? Should we try to 'tinker with' man himself, or should we adjust the environment in which he has to function?

3.1 Different approaches

As mentioned earlier, there are different types of human errors: a person can do something unintentionally, such as performing an operation in an incorrect manner (a 'slip'), or neglect to do something because he/she was distracted (a 'lapse'). Another possibility is performing precisely the action one intended to, only to find that the intention itself was incorrect: the person involved misjudged the situation (a 'mistake'), or the person knew that he/she was about to do something wrong, only he/she thought that the consequences of such a violation would be limited (a 'violation').
Each of these different forms of human failure, ranging from unintentional mistakes to deliberate violations, requires a separate prevention strategy. Roughly, we can distinguish six ways to prevent human failure:

1. making the working environment `fool proof';
2. giving instructions;
3. reward and punishment;
4. increasing motivation and alertness;
5. hiring better qualified personnel;
6. adjusting the working environment.

We will now examine if and to what extent each of these approaches may contribute to limiting the occurrence of human failures in the railway system.

1. Making the working environment 'fool proof'
One possibility is trying to design equipment in such a manner that incorrect operations are simply not possible, that errors are corrected or contained, or that the equipment 'forces' the user to perform the desired operations in the correct order. This approach to prevent human failures by technical measures has been very successful in the past and has resulted in distinct technical improvements in terms of safety. However, if one were to implement more technical improvements to prevent all of the accidents still occurring today, this would require investments that would be disproportionately large, and so this method holds less favourable possibilities for any further improvements. In addition, these types of technical facilities often offer new possibilities for people to make new errors. In some cases, these may present an even greater risk than the errors that were eliminated, because the modified system does not, and can not, take the new errors into account.

When it comes to making errors and side-stepping safety measures, people are incredibly resourceful. Subsequently, any attempt to design equipment in such a way that it can withstand the 'creativity' of the employees is doomed to show a 'leak' sooner or later. That doesn't alter the fact that designers should do their best to create equipment in such a way that the design takes a number of the frequently made mistakes into account. However, the costs involved in safeguarding equipment against human failures are often very high, and the more mistakes one tries to prevent, the more this is the case.

2. Giving instructions
Instructing employees in detail on what they are supposed to do, and informing them of the dangers which may present themselves before they begin a task, is certainly a possibility. However, even though it is customary to discuss work matters within the organisation of the railway, it would be impossible to give each employee detailed instructions before each and every task. The costs of personnel (instructors) and the costs in terms of unproductive time would be enormous. Besides, one of the main reasons for hiring experienced personnel is exactly because they are capable of performing a task both independently and correctly and they can solve any problems which may occur if things don't go as planned.
Furthermore, giving specific instructions will only result in a slight decrease in the number of 'slips', the unintentional actions which are performed automatically. At first, it may be possible to break through the routine character of certain operations by giving instructions, but after a while the instructions themselves will become routine.
It may be stated that we can expect limited results from giving specific instructions. It does affect the number of mistakes to a certain degree, but it scarcely prevents routine errors and it doesn't prevent violations in the least.

3. Reward and punishment
Influencing behaviour by means of reward and punishment is a technique that has been used since way back. The dismissal of employees, or taking criminal action against persons involved in an accident, is not unusual. The idea behind these kinds of measures is that the person involved consciously performed a series of operations which resulted in the accident. At the very least the person involved neglected to demonstrate a degree of awareness that would have made him/her realise that a situation was developing that would result in an accident. However, accident analyses have revealed that the person(s) involved were often completely unaware of the fact that an accident was about to happen. There is no point in using punishment as a means of preventing accidents, because people are usually not aware of the fact that they are doing something wrong. At the very most, it may be possible to prevent some of the violations which people deliberately commit. Furthermore, the technique of reward and punishment requires an extensive control system and it is questionable whether this is desired.
Reward may prove effective in promoting desired behaviour, especially in a learning stage. However, if desired behaviour is to be rewarded, it is necessary to make an inventory of all of the forms of behaviour that one wishes to reward first. The number of ways in which people can behave is enormous. Furthermore, many of the desired forms of behaviour cannot be influenced by reward. If, for example, a task is just too difficult, reward will not do any good.
Summarising, it may be stated that reward and punishment has at best only a moderate effect on preventing specific undesired behaviour. In most cases, however, it is pointless to punish the person(s) involved in an incident. Because no one deliberately causes an accident, punishment of this kind will have no beneficial effects in terms of prevention.

4. Increasing motivation and alertness
These types of measures are what we generally expect from psychologists. Though to a lesser extent than before, accident reports often reveal that the cause of an accident is

attributed to a lack of motivation, alertness or 'safety consciousness' on the part of those involved. This is because it is often so difficult to understand why people did not see an accident coming. Subsequently, the fact that no measures were taken to prevent the accident must be seen as a demonstration of laxness and a lack of motivation. As indicated above, the person(s) involved in an accident scarcely ever see an accident coming ahead of time, because they only have part of the information at their disposal and because the concurrence of circumstances is often so unique and simply unforeseeable. This doesn't have anything to do with a lack of motivation, alertness or 'safety awareness'.

Investigations into the causes of accidents at sea, accidents within the police force of Amsterdam and accidents in the gas and oil industries reveal a factor such as 'inadequate motivation' to play little or no role and so it offers no opportunities to effectively improve the situation in terms of safety. If motivation had anything to do with the occurrence of these accidents at all, the problem was more likely <u>too much</u> motivation in order to 'get the job done' than a <u>lack</u> of motivation.

5. Hiring better qualified personnel
The idea that people who are involved in accidents are 'stupid' often leads to the conclusion that organisations should hire smarter and better qualified personnel. It is believed that these 'super staff members' may be more capable of assessing the dangers the work involves. However, misjudging risks is not an important factor when we look at most of the types of human failure. In addition, one should keep in mind that being over-qualified for a certain function may have all kinds of negative effects as well.
Naturally, the quality of the personnel is a factor as soon as the employees fall short of the level required to do the job. And so, replacing well-qualified personnel with unskilled personnel will certainly lead to an increase in the number of errors which occur during railway activities.

6. Adjusting the working environment
It should be obvious from what has been stated above that attempting to directly influence human behaviour known to result in incidents and accidents (by giving instructions, using reward and punishment techniques, or increasing motivation) cannot be very successful. The effects of other approaches are only moderate as well, or the benefits cannot compensate for the costs. However, it is possible to point out environmental factors which bring people in a position or state in which they are inclined to make more errors. A train driver in a 'hasty' state will be more inclined to make a mistake than a train driver in a calm state. Hanging up signs in the train which say 'don't hurry' will not be very effective. A more effective approach to the problem would be to focus on the factors which caused the haste, such as 'poor planning of the activities' or 'a too busy schedule'. In turn, the cause of poor planning may, for example, prove to be how the management of the company weighed `working safely' and `making a profit' against each other. The decision to have 20 people do the same amount of work that was previously performed by 35 people is a conscious decision, not a mistake. It is not possible to predict who will make an error and at what time, but it is clear that if people are forced into a state of 'haste' by an increased work load, the chances of them making a mistake will sharply increase. Seeing that the employee was forced into a position in which he/she was bound to make an error sooner or later, it is not reasonable that the employee be held solely responsible for this error. Naturally, this does not mean that the employee has no responsibilities in the matter: once he/she observed the need to hurry, he/she could have refused to carry on. However, this imposes a heavy burden of responsibility on the part of the employee who, in view of the employment situation and the hierarchical structure of most companies, is not usually in a position to refuse to work.

3.2 The system approach: improve the organisation

If we are to realise a further reduction in the number of accidents, we should no longer focus our efforts on the working man. Programmes to increase motivation, repeated instructions and a stricter system of checks for ensuring that employees observe the regulations, will have little effect: such measures do not prevent slipsand lapses and only prevent mistakes and violations to a limited degree. Increasing the chance of being caught in the act of committing a violation will certainly not always result in people adjusting their behaviour. As long as people are given the opportunity to break a rule, and as long as the work situation invites them to, for example because there is only a certain amount of time available or because 'this is how it's always done', employees will continue to display this undesired behaviour.

Most of the accident analysis systems focus relatively little systematic attention on preventing human errors and on optimising human behaviour by improving the organisation in which people have to work. Investigations into the disaster which occurred with the ferry Herald of Free Enterprise and the explosion on the production platform Piper Alpha in the North Sea have clearly revealed that efforts to prevent these types of disaster should not be focused on man or his technical environment, but on the company's poor organisation. This does not only apply to disasters, but to accidents on a smaller scale as well.

SAMOS offers a method for accident analysis which combines various ways to influence the human factor. The model it contains can be applied to larger and smaller accidents, environmental incidents and health hazards. In addition, an attempt is made to make an inventory of the factors which put people into a position in which they will display 'unsafe behaviour' or make errors. Using this inventory, the management staff of companies can determine which measures will be most effective in limiting the human factor in the process of disruption and, with that, which measures offer the best results in terms of increasing safety. As is also presently the case in the field of quality control, we are focusing more and more on process control and less on controlling the end result. WHAT went wrong (the specific incident and the consequences), is not as important as AS A RESULT OF WHAT: the abnormalities in the process which resulted in something going wrong.

4 SAMOS

4.1 Introduction

As described above, accidents, (environmental) incidents and health hazards do not just appear out of the blue: the ultimate causes of such events can often be found in the distant past. When writing a research report following an accident, a researcher can present the 'circumstances' of an accident in the form of a scenario. The sequence of events is largely brought to light and the result is a chronological survey of what led to the undesired situation.

The standard procedure in accident investigations is to depart from the last phase in the process. Using logical reasoning, investigators attempt to discover the underlying causes of the accident, or to gain a clear view of the factors that contributed to the accident.

Examples include the STEP- (Sequentially Timed Events Plotting) and MORT- (Management Oversight and Risk Tree) method. There are countless methodologies which focus a certain degree of attention on behaviour-related factors. In most cases, these are visualised with a herringbone model, or are presented as variations on Heinrich's domino's, such as SCAT (Systematic Causal Analysis Technique). A characteristic feature of accident analyses is their retrospective (looking back) nature.

However, this approach has its disadvantages. The reliability of the final results of the analysis is relatively low, and the results are strongly influenced by the style, interests and background of the researcher and by the culture prevailing within the organisation.

SAMOS (and Tripod) on the other hand uses a different approach. One that focuses on the different phases in the process of disruption. Each phase has its own distinguishing features and also varies in the degree to which the management can exercise control over it. As the model presented here only describes the accident chain which leads to human failure, it cannot replace a detailled technical analysis of a failing system or an undesired exposure. However, because organisational failures often lie at the root of technical failures, one will frequently find that the chain can also be applied to accidents which, at first sight, appear to be solely technical in nature.

4.2 The underlying philosophy on accident causation

An important component of SAMOS is the description of the accident process. Accidents, or other undesired disruptions in the normal routine of things, do not occur 'without reason', but are the result of a concurrence of circumstances. Attempting to 'manage' the accidents themselves, is an impossible task: there are just too many coincidences involved. Which is why SAMOS focuses on preventing the concurrence of circumstances by identifying and eliminating the risks which will lead to these circumstances. A simple graphic representation of the underlying accident model is shown in figure 1.

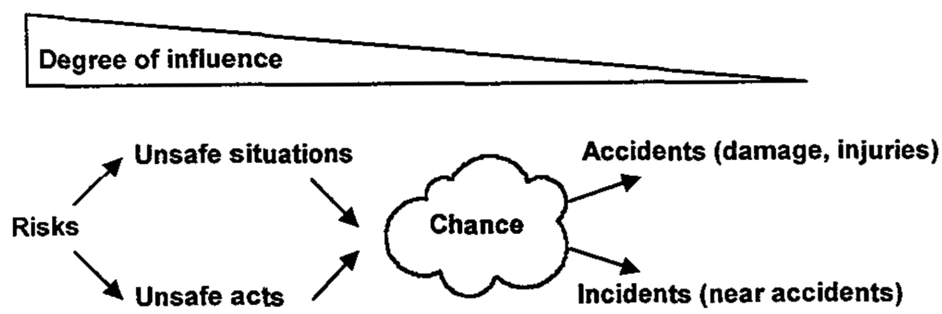


Figure 1 *A simple representation of accident causation*

The accidents and 'near accidents' or 'incidents' are indicated at the right. These are the result of dangerous operations or dangerous circumstances. Whether these will subsequently lead to an accident or a 'near accident', is primarily determined by chance: it is almost impossible to influence the outcome.
The dangerous circumstances and dangerous operations are more to the left side in the figure. Undesired disruptions in the operations only occur if these two coincide. And so it

seems obvious that we should ensure that they no longer occur or, if they do occur, that they are identified and subsequently eliminated as quickly as possible. However, it would be impossible to detect and eliminate each and every one of these dangerous operations and situations. In addition to that, reports on dangerous operations or situations generally focus on technical factors, rather than on organisational factors. A loose screw bolt or a crooked pipe is included in the report as a situation that is not safe, but the fact that a CARGO-manager calls up and, for example, gives the order to give a cargo train right of way over a passenger train, even though this is against procedure, is usually not considered to be a dangerous situation. Even so, the investigations into recent disasters tell a different tale: it is not so much the technical aspects that contribute a great deal to accidents, but rather these *organisational aspects*.

It is much more effective and efficient to focus on the causes of these dangerous operations and situations: the risks. How did these circumstances come about, and can we prevent them from happening before they result in undesired disruptions? These risks are factors which can be influenced by the management, and so they can be controlled to a great extent. These are the answers to the question 'How is it possible that such a dangerous situation occurred, or that a dangerous operation was carried out?' If we can locate, examine and eliminate these risks, employees will no longer find themselves in a situation in which they may display dangerous behaviour.

4.3 The accident model

As mentioned earlier, SAMOS is based on the Tripod method which was developed in Leiden. The Tripod method distinguishes between the following phases in the accident process:

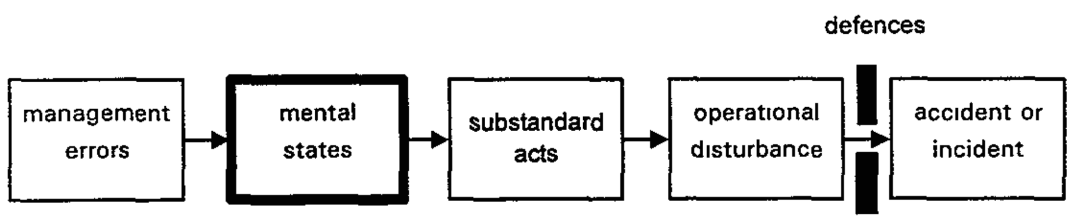


Figure 2 *The various phases of the accident process (Tripod -model)*

The diagram in Figure 2 displays the model as a process of disruption which consists of a number of phases. The model can be used for large-scale disasters and accidents and incidents, as well as for health problems resulting from exposure to hazardous substances. The model can be used regardless of how much time has gone by between the time the unfavourable environmental factors were created and the ultimate negative result (whether this is an hour, a month or twenty years). The term 'incident' is used to indicate what one wishes to avoid, whether this is a safety, environment or health problem.

Prior to an accident occurring or someone becoming ill, the safety measures existing within the organisation either did not function sufficiently or were absent. If someone suffers a loss of hearing (the incident), this may be the result of failing hearing protection devices: they are not present, they do not function sufficiently, or they are so uncomfortable that the victim no longer wore them (the failing safety measures). There are different ways in which to solve this problem. For example, we may ask ourselves why there was so much noise in the workplace, and why the person involved was not, or not adequately, protected by hearing protection devices. Too much noise (the disruption in operations) may for example be the result of someone deliberately not closing sound-proof hatches (sub-standard operation). The person involved thought it convenient to keep the hatches open while working, but became irritated because of the noise (the mental state). The fact that it was unpleasant to work with the hatches closed, was brought about by the insufficient design of the machines (management did not control the process of design to a sufficient degree). When using an approach which focuses on process control, this problem cannot be dealt with by simply pointing out to the person involved that he/she has to wear protective devices. The effects of repressive measures of this kind are very limited and they can only be effective in an environment where it is possible to continuously keep check on the observance of the regulations, and in which it is possible to predict what people will do right and what they will do wrong. In this case it is much more effective to focus on the source of the problems: the incorrectly designed equipment. Furthermore, it should be looked into why this piece of equipment was bought in the first place, and why it was not known before now that the equipment did not function properly or, if it was known, why nothing was done about it. These types of 'mistakes' on the part of the management can be arranged into a limited number of risk areas in the organisation: the 11 Basic Risk Factors (BRF's).

4.4 The BRF's

It is plain that we can identify a 'human factor' in every accident or unintentional exposure: someone, whether unconsciously or deliberately, did something that was not consistent with what is considered to be the correct operations at that particular company: the sub-standard operation. This person, before he or she did this act, was in a certain mental state, for example irritated, in a rush, or misled: which brings us to the next phase in the model. It has a broad black edge around it in figure 2: years of psychological research have shown that it is virtually impossible to directly influence these kinds of mental states of employees. It is much more efficient to adjust the environmental factors in such a way that employees no longer reach a certain unfavourable mental state which would cause them to perform a 'sub-standard' operation. These factors, the so-called General Failure Types (GFT's) or Basic Risk Factors (BRF's), can however be influenced by the management. There are eleven of these 'control areas' (see table 1).

No.	Description and abbreviation
1	The quality, state, availability and usability of the infrastructure, materials, equipment and tools: Hardware (HW);
2	The ergonomic design of the infrastructure, materials, equipment and tools: Design (DE);
3	The organisation and the manner in which maintenance, repairs and inspections are carried out: Maintenance Management(MM);
4	The availability, comprehensibility, usability and correctness of work procedures, regulations and manuals: Procedures (PR);
5	The physical and social working conditions in the workplace and individual factors which increase the chance that errors will occur: Error Enforcing (EE);
6	Daily maintenance and cleaning of the workplace:Housekeeping (HK);
7	The management of conflicting goals such as working conditions versus production: Incompatible Goals (IG);
8	The communication between employees, departments and business units: Communication (CO);
9	Steering processes and persons, the structure of the organisation in which people have to work: Organisation (OR);
10	The education, experience and selection of employees: Training (TR);
11	The existence and effects of control measures and safety means as part of the philosophy of the company: Defences (DF).

Table 1 *The eleven Basic Risk Factors (BRF's).*

Each of these eleven BRF's is present in every organisation to a certain degree, whether accidents occur or not. These BRF's, depending upon the extent to which they apply, cause people to reach a state in which they are more likely to make an error. If, for example, the necessary equipment is defective or not available, chances are the employee in question will improvise in order to get the job done, and then make an error when doing so. The most important aim in an organisation's policy on safety should be to deal with the underlying factors which may result in human failure. It is possible to make an inventory of these mechanisms and to develop an instrument that can measure their impact: The SAMOS accident analysis methodology.

By optimally managing all of these factors, the employees of a business unit will hardly ever reach a mental state which causes them to make errors which, in turn, will lead to disruptions in the production process. The aim is to tackle the source of the errors, rather than focusing first and foremost on the errors themselves. In order to influence the human factor as effectively and efficiently as possible, it is necessary to take active measures in the earliest possible phase of the process: at the level of the BRF's.

There is already a variety of instruments available, both for making up an inventory of risks and for risk evaluation, which can provide insight into the state of a company, and which may serve as a basis for taking measures. Depending upon which approach is followed, these techniques focus on the various phases of the disruption process in figure 2.
Each technique has its limits, and none of them can replace all the others. It would not be wise to rely too much on the effects of one technique alone, especially if the technique cannot detect and identify any errors until late in the accident process. Incorrectly designating the actual problem will result in incorrect recommendations. Experiences in traffic safety with ABS-systems (anti-block systems) and airbags in automobiles, reflectors on bicycles and having motorcycles drive with lights during the day, reveal that the effects of technical measures, thought to be very effective, on the

number of accidents, are sometimes negligible. The phenomenon 'risk compensation' should also be taken into account in the work situation. Prevention is the best cure, but it is simply not possible to control the whole world and so defensive techniques are (still) necessary in each phase of the process.

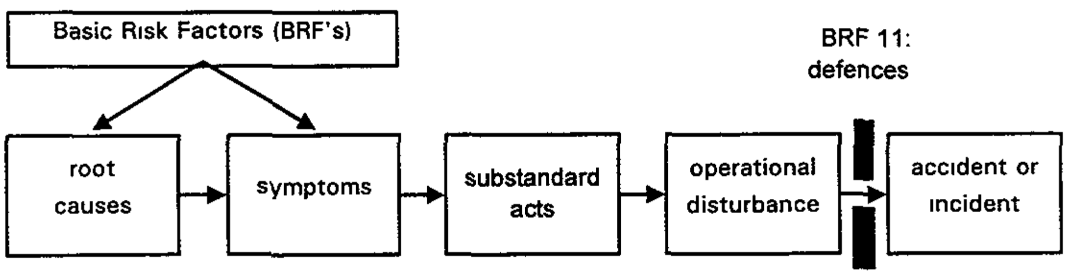
It is possible to measure the contribution of the eleven BRF's for each accident. This analysis reveals the sources of human failures in specific accidents or series of accidents.

4.5 The SAMOS method of analysis

The eleven BRF's can be found at the beginning of every cause-effect chain. In order to positively influence these factors, so that employees no longer perform incorrect operations, it is possible to measure their relative influence within the scope of a risk inventory and risk evaluation. Following an accident, one can analyse the circumstances surrounding the accident and then subsequently categorise the causes in terms of the BRF's. The identification of the contributing factors and the subsequent classification in terms of the BRF's can be performed in a very reliable manner using the SAMOS analysis instrument.

The SAMOS analysis instrument aids Railned researchers in detecting BRF- **symptoms** and the **root causes** of these symptoms in a structured manner. All of the information is divided into one of the 11 BRF's. The instrument consists of two checklists and, for each BRF, a number of items which fall under this BRF: the Symptoms list and the Root Causes list. The Symptoms list is used to identify all of the symptoms which contributed to the development of an accident or incident. Furthermore, the sub- standard acts which resulted from these symptoms are designated as well. The next step is to locate the structural, underlying causes of the occurrence of the symptoms using the descriptions of the problem areas in the Root Causes list.

The *method is based on the modified general accident chain as shown below:*



The 11 **Basic Risk Factors (BRF's)** *are 11 different "control areas" which can be* distinguished in every organisation, or part of an organisation. The extent to which the BRF's are controlled is assessed by identifying and "counting" the symptoms which contributed to the development of accidents and incidents. Poorly controlled BRF's result in many symptoms, and so they are the main sources of risk.

Root causes are structural deficiencies in the organisation and the working environment. They are the result of inadequate decisions on the part of the management. They are the most controllable elements in an accident chain, because they lie at the root of all other events to come. They often concern hidden deficiencies which are only revealed during an in-depth investigation.

Symptoms are local problems which are present in the workplace before an accident or incident occurs and which are the result of Basic Causes. Symptoms are faulty, inappropriate or absent means, dangerous situations or the ' psychological precursors' of dangerous operations: unfavourable mental states of people.

Sub-standard acts are the final links in the accident chain, before the disruption in operations occurs. These concern dangerous operations (or: neglecting to perform necessary operations) which are the result of symptoms being present. They are the concrete, visible result of human failure: unintentional blunders (slips), lapses, mistakes or conscious violations.

The **Operational disturbance** is the direct result of a sub-standard act. It is the moment at which a process deviates from normal, and a situation involving risks occurs. It must be viewed separately from the nature and magnitude of any consequences. The operational disturbance is the starting point of every SAMOS-analysis because this is what we initially want to prevent.

Defences are the systems, procedures and actions which should be present in order to prevent or limit the effects of a disruption in operations, once such a disruption has occurred. The effectiveness of the safety measures is determined by BRF 11:Defences. If there are no sufficient means of protection, the disruptions will result in accidents more often, and the consequences will be more serious.

The **accident** or **incident** is the effect, or result, of an operational disturbance that is not "counter-acted" or contained by adequate safety measures.

By way of illustration, we will now pass through the accident chain in reverse order (starting from the accident back to the basic cause) by means of a simple industrial accident: a mechanic has to do maintenance work on a high-tension installation, creates a short circuit, and receives a life-threatening electric shock.

The **accident** is: 'mechanic receives life-threatening electric shock'. The **failing defence**: 'work gloves not suitable, no insulation'. The **operational disturbance**: 'the occurrence of a short circuit'. The **sub-standard act** is: 'mechanic makes error by using incorrect tools'. The **symptom**: 'suitable tools not at hand'. The **root cause**: 'inadequate storage or purchasing system'. The two BRF's which 'scored' are 'Hardware' (suitable tools not at hand) and 'Defences' (protective gloves not adequate).

Besides being a methodology for research and screening, SAMOS is also a **safety measurement tool**. The method assesses the risks systematically and in terms of quantity. Every time a certain BRF is involved in an incident, the BRF's score is "increased". A BRF-profile can be made by adding up the factors involved in various incidents. This provides a reliable picture of the degree to which each of the BRF's is controlled in an organisation or part of an organisation. BRF-profiles can be made for the entire railway traffic system, for each transport operator, for each business unit or for a local department of a business unit.

This results in a profile as shown in figure 4.

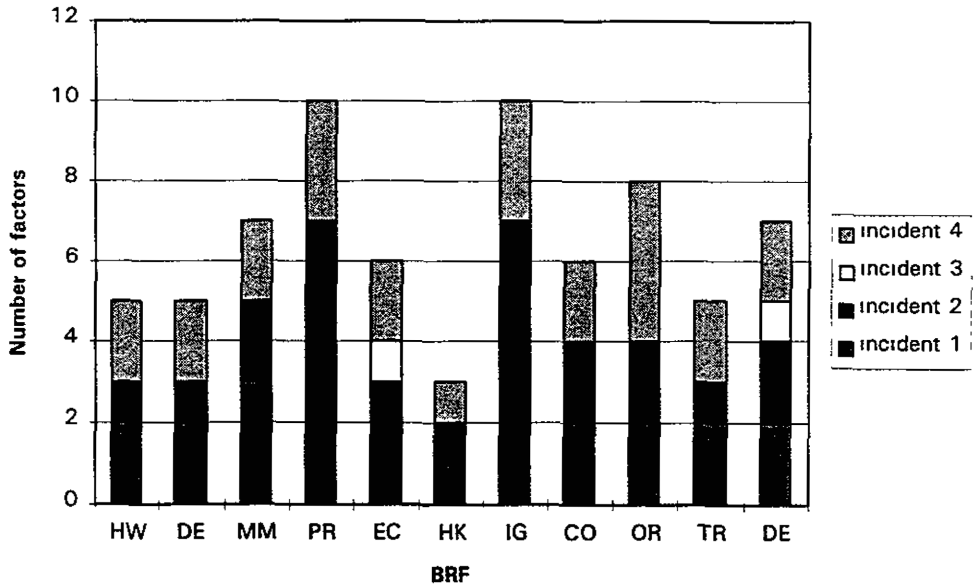


Figure 4 *An example of a profile of four accidents*

Some BRF's score highly in all four accidents: Design, Procedures and Incompatible Goals. Which means that we detected factors that are directly related to one of these BRF's in each of these accidents. If the profile of accident 2 is compared with that of accident 1, Design proves to be a problem as well, whereas Housekeeping, though significant in accident 1, is not shown to be a problem in any of the other accidents. It is also possible to combine analyses of accidents, incidents and audits. In addition to the recommendations that can be made on the basis of the individual analyses, the resulting combined profile can be used to consider more overall measures.

The BRF's give an indication of global problem areas. A high score for a BRF indicates that there is a problem in this area, but it provides no clear indication of the source of the problem. So it is necessary, if improvements are to be made, to 'zoom into' the concrete root causes. Concrete measures to improve the situation can be implemented at this level. If, for example, the BRF Design has a high score, this may be the result of a variety of bottlenecks at the organisational level. A lack of standardisation, for example, may be the cause of many Design- problems, or they may be the result of a shortage in time or resources available for the (further) development of systems.

5 Conclusions

In this introduction of the SAMOS-methodology, we discussed the relationship between human errors and accident prevention. Human failures are very difficult to control. Adjusting the work situation and the organisation in which people work, is a promising approach. We need to deal with the situations in which people almost can't help but fail, instead of focusing on the employees who make mistakes/errors. They do not *take* risks, but are primarily *at risk*. Naturally, it is essential that the management gains insight into what these poor working conditions are exactly, and what kinds of steps they should take to improve the situations. SAMOS does both.

The method we have described is not a 'miracle drug' in the field of safety. It is an addition to what is already being done in the field of safety within the railway system. The high level of safety already found in most of the business units, has been achieved by successfully applying these techniques. However, this method focuses on an important component of the accident process, the human factor, and how the management can control this factor as effectively as possible. An important aspect of this approach, is that the management should only try to control what it can control, and that no measures are taken which cost a great deal of time, money and effort, but which lack result because they are based on an incorrect philosophy on safety, or because they were taken at the wrong level. Tackling the human factor starting from the philosophy of control, is an underexposed approach in most other analysis techniques.

The method we have described has the characteristics of both an inventory technique and an evaluation technique. The method provides an assessment of the risks or, to put it in a better way, the underlying factors of the risks, whereas the 'importance' of these risks is determined by 'clustering' factors at the level of BRF's. Which means that if specific risks are to be arranged in order of magnitude, this may require other additional techniques. Human Reliability Assessment (HRA) -techniques, for example, can be used to estimate the chance that specific errors will occur.

SAMOS allows the user to evaluate the effectiveness of safety care systems with respect to the extent to which the management has control over the human factor. The question is not *whether* there are certain statutory procedures in the business unit with which employees must comply, but rather if the employees have a clear understanding of these procedures and if there are certain circumstances in which the procedures cannot be adopted or are inadequate. This evaluation can be carried out *independent* of the safety care system in use. The result is an objective measuring staff that can be used to compare companies and departments, and that provides a reliable picture of any improvement or decline occurring between two consecutive measurements.

In addition, the approach we have outlined here can also be very useful when answering the question: 'Where does the risk come from?' and so it offers opportunities for improvement.

In recognition of everything that has already been accomplished in the field of safety by using other techniques, it would seem that the most important improvement in the safety condition of a company can be achieved by tackling the sources of the errors. This process approach has strong similarities with the 'Quality-programmes' that are currently being used in many companies, and the method also concurs with the ISO 9000- and 10000-series. We should not focus on 'human beings who make mistakes' , but on the situations which cause people to make errors. Safety does not stand alone in this view, but is the automatic result of optimally managing a company. Working in a safe and healthy manner is not so much the responsibility of the individual employee, but mainly that of the management of the organisation in which people work.

International Rail Safety Conference

1997 LUCERNE

21 May - 23 May 1997
Swiss Transport Museum, Lucerne, Switzerland

Paper 9712

Satoshi Nakai

Crisis Management in the ELRC: Taking the example of a major earthquake

Publisher
2000 International Rail Safety Conference

Schweizerische Bundesbahnen
Chemin de fer fédéraux suisses
Ferrovie federali svizzere
Swiss Federal Railways

INTERNATIONAL RAILWAY SAFETY CONFERENCE (IRSC) 1997
21 to 23 May, Lucerne / Switzerland

PAPER:	**Security and Safety Training Crisis Management in the EJRC; Taking the Example of a Major Earthquake**
PRESENTED BY:	**Mr. Satoshi Nakai Manager**
DATE:	**21.05.97**
SESSION:	**III**
TIME:	**1500-1530**

Crisis Management in the East Japan Railway Company
— Taking the Example of A Major Earthquake —

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Transport Safety Department
East Japan Railway Company

1. Basic Philosophy of Crisis Management

Firstly, the basic philosophy behind crisis management in the East Japan Railway Company will be described.

What is referred to here as "crisis management", can be defined as "the specific study of the methodology and putting into practice of the actions to be taken by those responsible for crisis management at each of the various crisis stages; namely, crisis occurrence and consequence prediction and forseeing, crisis prevention and avoidance, coping with and preventing escalation of the crisis, and prevention of its recurrence. Typical examples of crises are war, socioeconomic unrest, major accidents or disasters, and destructive or atrocious crimes. In present day Japan, in relation to railroads, the most likely of these to occur is a major accident or disaster

The potential for such crises always exists in various forms. With regard to this potential, the important thing is not to simply deal with isolated occurrences on a "one-off" basis, but to be aware of the reality and danger of such occurrences, frequency of occurrence, seriousness of the outcome, as well as to predict the ability as a company to respond, and to set suitable priorities for the investment of the limited money, manpower, and materials that are available.

In order to foresee and predict the outcome of a major accident or disaster and to prevent or restrict the consequent damage or casualties, there is a necessity for each employee, as well as for the company as a whole, to foster an awareness of these matters and take precise action.

For this reason, at the East Japan Railway Company measures are being taken with regard to the prevention of:

- Train collisions
- Grade crossing accidents
- Accidents during work such as track maintenance.
- Fires at stations
- Disasters such as earthquakes or deluges

These measures are being taken in both in physical and abstract terms, based on the concept of "not waiting until an accident occurs to take action, but rather to always be taking action to ensure safety".

Crisis management is usually performed in accordance with the following procedure:

(1) Determine the warning signs of accidents or disasters, or the probability of their occurrence.

(2) Predict the form of and estimate the scale of the accident or disaster.

(3) Make the necessary preparations.

(4) Take the correct action in the event of an actual occurrence.

(5) Take the necessary measures to prevent recurrence.

In the past, steps (4) and (5) have received most of the attention, but more recently, efforts have focused on performing (1) and (2) with accuracy.

From the idea that the man in the field is in the front line when it comes to quick recognition of the warning signs that could lead to a major accident, a prevailing safety consciousness must be fostered in which each employee must maintain safety vigilance and act autonomously.

2. Response to a Crisis — Preparedness for Rescue in the Event of a Major Earthquake in the Tokyo Metropolitan Area —

Despite the fact that we are taking the preventive measures described above, crisis situations do occur. To indicate the way in which the East Japan Railway Company would respond to a crisis, the following example describes JR East's preparedness for rescue in the event of a major earthquake in the Tokyo metropolitan area.

Japan is a country of frequent earthquakes with large earthquakes occurring and causing damage in all regions. Two years ago in Kobe, about 600 km west of Tokyo, an earthquake of magnitude 7 on the Richter scale rocked the city causing extensive damage to a large number of buildings, roads and railways, and more than 5000 lives were lost. In Tokyo too, past records show that major earthquakes have occurred periodically, and it is believed that the city is likely to suffer a major earthquake in the not too distant future.

Therefore, with regard to the crisis management procedure described above, the aim is to make preparations (3), based on the predictions and estimates of (2) and take the correct action in the event of an actual occurrence (i.e., (4)).

2.1 Basic Policy

Hypothetical Conditions

- A major earthquake of magnitude 6 to 7 occurred in the vicinity of Tokyo resulting in derailments, overturned railway cars, destruction of station buildings, and a corresponding large number of fatalities and injuries among the passengers.
- Railway lines and roads were severely damaged and telephone connections were disrupted.

In order that rescue operations can proceed smoothly even under these conditions, specific measures are taken in line with the following four basic principles:

(1) Each individual employee must act autonomously in accordance with the manual.

In the case of a major earthquake, there are situations where action based on the chain of command would be impossible. The action to be taken by employees when there is no instruction are laid down in the form of a manual and autonomous action taken according to this manual.

(2) A "Main Office Crisis Headquarters" direct command system is provided.

Action is carried out in accordance with precise instructions via a command network at the heart of which is the "Main Office Crisis Headquarters" at which a rapid and precise grasp of the crisis situation is maintained.

(3) Action should be taken with the main priority on completing rescue operations involving human life within three days.

Rescue operations should be performed on the maximum possible scale in order to complete them within the first three days which past experience shows gives the highest probability of rescuing victims alive. To achieve this, material and human assistance is necessary from regions unaffected by the disaster.

(4) Rescue efforts should include employees and their families as well as passengers.

2.2 Specific Measures

(1) Rapid Stopping of All Trains When the Earthquake Occurs

To reduce subsequent damage to a minimum, when seismographs located along the tracks sense a tremor in excess of a predetermined value, a breaker switch at the Shinkansen transformer station is automatically activated to cut off the power supply to the Shinkansen trains and bring all trains to a halt. In the case of a conventional train, a wireless message is automatically transmitted to the driver who will stop the train. The wireless system employed for this is a dual system.

(2) Rescue Organization

So that rapid assessment of the disaster situation can be made at the main office crisis headquarters and rescue personnel dispatched with precision, information contact points and rescue relay bases are predesignated within the normal organization. In addition, field crisis headquarters are set up at individual crisis locations.

If the Tokyo main office is damaged to the extent that it becomes non-functional, the branch office at Takasaki, about 100 km away becomes the main office crisis headquarters.

The respective functions are as follows:

- Main Office Crisis Headquarters

Overall command and supervision of the company's rescue operations.

Functions as a contact and liaison point with external organizations.

- Information Contact Points

  Reports the conditions and rescue activity status for the region to main office crisis headquarters and receives instructions from head office and passes them on to the field crisis headquarters.

- Rescue Relay Bases

  Arranges the rescue equipment and personnel from regions unaffected by the disaster and sends them to the field crisis headquarters.

- Field Crisis Headquarters

  Set up at stations or locations such as derailment sites to directly control the rescue operations.

The organization is arranged as shown in Figure 1, and the rescue activities develop throughout the entire company.

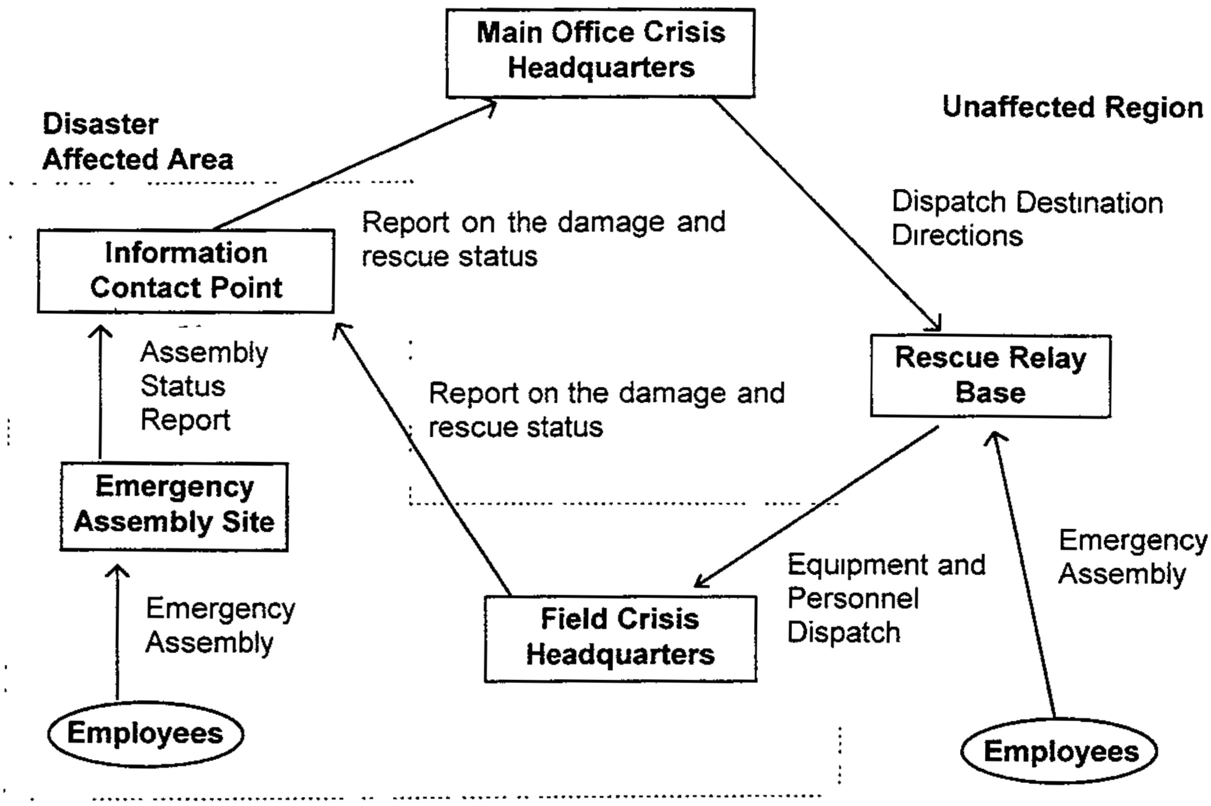


Figure 1 The Structure of the Rescue Organization

(3) Achieving a Means of Communication

- Facilities have been installed to enable satellite communications between the main office crisis headquarters, information contact points, and rescue relay bases.
- The means of communication with stations, rolling stock depots, and other field sites involves three separate systems. They are company wireless, NTT public telephone lines, and NTT cellular telephones.

(4) Stores of Food and Rescue Equipment

- Stores of food for 100,000 meals and temporary toilet units that can be used a combined total of 160,000 times have been installed at information contact points, rescue relay bases, and other locations to provide for the daily requirements of 30,000 people for three days.

- The equipment and vehicles required for safety operations have been allocated to maintenance yards, rolling stock depots, and other various locations.

  In addition, various types of construction equipment and food have been stored at companies contracted for daily maintenance.

(5) The Criteria for Employee Action

The following actions, that are laid down in a manual, are expected to be taken by company employees even when there is no direct supervision.

- Gather at emergency assembly points

  Employees, on confirming the occurrence of a major earthquake via television or other news media, or from the condition of their surroundings, make their way to emergency assembly points (their nearest station or place of work) taking food or other immediately necessary items with them.

- Report their personal status to their workplace or a secondary contact point.

  The secondary contact point is a specified location to be contacted in the event that their own place of work has suffered damage to the extent that contact has been made impossible. To ensure that the secondary contact point is not also affected by the disaster, a location at least 100 km away is specified.

- Rescue and provide first aid to the injured
- Those in charge of a location affected by the disaster should set up a field crisis headquarters and commence rescue operations.

(6) Verification and Support of Employees Safety

When the whereabouts of an employee is unknown, personnel are sent from the station nearest the employees home to verify the situation and to rescue or provide other necessary assistance.

(7) Collaborate with Administrative and Other Bodies

Liaison with national or local administration, the fire department, police, or self defense forces is set up and the form of cooperation in the event of an earthquake is mutually agreed upon. As a result of this, mutual exchange of information regarding such matters as the status of earthquake damage is achieved, and in addition to receiving assistance in the rescue operations, supervision is provided for the transportation of rescue materials and personnel by rail.

3. In Order to Provide the Desired Function in an Emergency

Having achieved the required state of preparedness, a necessary step in crisis management is to ensure that when an actual accident or disaster occurs, the desired functions will be provided according to plan. The following are being carried out to ensure this:

- Manuals outlining the action required are provided to all of the company's 80,000 employees.
- Management are provided with more detailed manuals so that they may provide suitable supervision.
- Comprehensive simulated disaster drills are carried out throughout the company once every year. These trials are participated in by the company president, main office personnel and 20,000 other employees who all perform their respective roles.

- Simulated derailment recovery drills are performed at various times in combination with local government and the fire department on a regional basis.
- Employees are receiving first aid training. This training will be given to 20,000 employees over the following three years and finally extended to all the company employees.

4. Conclusions

Crisis management in the East Japan Railway Company was described for the case of a major earthquake. In crisis management it is important in both the preventive stage and after actual occurrence that the employees act precisely as decided in advance by top management in accordance with their decisions and measures.

The philosophies described here are therefore effective in other situations, and are applicable on a smaller scale to train accidents or fires.

Such things as computerization and other facilities have been introduced to achieve more efficient operation in order to make the railway a safer, faster, and more comfortable means of transportation. As a result the frequency of accident occurrences has decreased and it is becoming more and more difficult to make use of past experience. On the other hand, as the system has become more complex, when an accident does occur, a high level response is required. It is therefore necessary to continue in our efforts to enable us to respond with precision in any kind of disaster or accident scenario.

International Rail Safety Conference

1997 LUCERNE

21 May - 23 May 1997
Swiss Transport Museum, Lucerne, Switzerland

Paper 9713

Jean-Bernard Benech

Safety Arrangements for Crossing Rail Tracks

Publisher
2000 International Rail Safety Conference

Schweizerische Bundesbahnen
Chemin de fer fédéraux suisses
Ferrovie federali svizzere
Swiss Federal Railways

INTERNATIONAL RAILWAY SAFETY CONFERENCE (IRSC) 1997
21 to 23 May, Lucerne / Switzerland

PAPER: Human Factor
Safety Arrangements for Crossing Rail Tracks

PRESENTED BY: Mr. Jean-Bernard Bénech
Head of SNCF's Safety Studies Center

DATE: 21.05.95

SESSION: IV

TIME: 1600-1630

CURRICULUM VITAE

Jean Bernard Benech

Jean Bernard Benech is an Aeronautical Engineer who was employed by SNCF in 1968.

1968 - 1980 (12 yrs)
He has been in charge of several local depots with electric and diesel engines. His job was to manage drivers, engines and rolling stock maintenance.

1980 - 1994 (14 yrs)
He has been a regional manager in charge of railway traffic operations (there are 23 regions on SNCF's network). Jean Bernard was in the Toulouse area, south of France, along the Pyrenees mountains, near Spain.

1994 -
Since 1994 he has been head of the SNCF's Safety Studies Centre, which is part of SNCF's Headquarters. His office is now in Paris where he maintains a global view of railway Safety problems with a systematic approach.

SAFETY ARRANGEMENTS FOR CROSSING RAIL TRACKS

❶ INTRODUCTION

❷ NATURE OF THE PROBLEM AND POLICY PURSUED

- Data collected from historical accident record
- General external background
- Selected courses of action

❸ IMPROVEMENTS TO LUMINOUS PICTOGRAMS FOR CROSSING RAIL TRACKS

- Description of the previous pictogram
- Analysis conducted from past incidents
- Identification of the previous pictogram's weaknesses and related adjustments

❹ SAFETY SIGNING SYSTEM

- General goal to be attained

- Principles adopted

a) Safety Signalling systems

b) Safety messages

c) Areas to be covered within rail stations

❺ PREVENTION

a) Rail station development operations conducted under partnership
b) Approach with the school medium

❻ CONCLUSION

SAFETY ARRANGEMENTS FOR CROSSING RAIL TRACKS

SUMMARY

Accidents in relation to crossing in-station rail tracks are a significant concern for SNCF.
In order to cut the number of accidents, French Railways have initiated a study on how to improve the existing safety arrangements for crossing rail tracks and the related in-station signing system. For the first time ever, this review was based on in-situ observations and passenger surveys. French Railways are also developing prevention campaigns aimed at schoolchildren, youth being sensitized about the train and how it should be used.

❶ INTRODUCTION

Since 1990, the observation and analysis of accidents to people have been entrusted to the Centre for Safety Studies which manages a dedicated database.

This exposition takes into account accidents to passengers crossing in-station tracks. Suicides, assaults and natural deaths are not accounted for.

❷ NATURE OF THE PROBLEM AND POLICY PURSUED

- Data collected from historical accident record

The accidents to people database of the Centre for Safety Studies are only concerned with accidents having caused fatalities or major injuries (more than three days in hospital) and involving rail vehicles in motion.

For the period extending from 01/01/1990 to 31/12/1996, 186 accidents to people crossing in-station tracks have been recorded. This category represents 14% of accidents to people (hit by a train and/or falling from a train).

Among the victims, 33% of fatalities and 46% of injuries have affected passengers, i.e. people holding a valid ticket.

- General external background

Accidents having occurred when crossing rail tracks are mostly due to a non-compliance with the rules and/or with the indications from railway signals. However, the mass media tend more and more to put the blame on French Railways whenever passengers have not at their disposal in a station any pedestrian passage, whether an overhead footbridge or a subway (underground passage).

Overall changes with the judicial background are also noted, the rulings from judges tending to hold French Railways partly liable on grounds that due resources for accident prevention have not been spent.

Selected courses of action

It is in this context that the recasting of statutory texts about passenger safety in station premises is taking place. This process goes hand-in-hand with a background review in relation to two specific issues:

.improvements to luminous pictograms
. passenger safety signing system

For the first time ever, a sociological and psychological approach focusing on passengers'habits and behaviours has been integrated into the design policy of safety devices for crossing rail tracks.

The emphasis has also been placed on the usefulness of preventative measures.

The improvements to luminous pictograms, the passenger safety signing system and preventative measures are addressed successively hereafter.

❸ IMPROVEMENTS TO LUMINOUS PICTOGRAMS FOR CROSSING RAIL TRACKS

Installation criteria include the activity of the station concerned and sighting conditions (local topography, climatic conditions...)

Installation criteria can be summarized as follows: over lines where the maximum train transit speed does not exceed 170km/h, fixed signals are recommended provided visibility is in excess of 10 seconds, the VT (1) station product does not exceed 150 and the maximum number of passengers simultaneously crossing rail tracks is smaller than 15.

If the Vt station product is at least equal to 2000 or if the threshold of 25 passengers crossing simultaneously is reached, an overhead footbridge or a subway is to be installed.

In the other cases, a luminous pictogram will be installed. Over the lines where train speeds are in excess of 160km/h, footbridges are used as pedestrian crossings.

(1) The VT train product is equal to the number of passengers crossing tracks multiplied by the number of trains passing over station tracks and « intersecting » the pedestrian right of way during a time interval from 20 min before passengers cross tracks until 10 min after they have cleared the tracks. The maximum transit speed in a station is taken into account. The VT station product is the summation of VT trains over one day.

Description of the previous pictogram

The facility consists of luminous signals housed in two overhead boxes situated on platforms Passenger who intend to cross tracks can see them clearly.

The graphics of the illuminated figure symbolizes the message « Do not cross », via a stylized image of an immobile standing figure by the edge of a platform.

Analysis conducted from past incidents

The analysis of victims'characteristics for accidents at crossing rail tracks has shown that a significant part (almost half) of passengers killed under such circumstances met their death in a station equipped with luminous pictograms, whereas that type of stations is only frequented by a bit more than 1% of our passengers.

This situation prompted the creation of a working party whose remit was to identify ways of improving the current system.

The working party has analyzed in detail the accidents when crossing rail tracks (datebase, accident files). This early work has been supplemented with:

- observations made on a number of experimental sites;

- results from the surveys conducted on these sites using different methods (questionnaires circulated to customers, observation forms completed by staff, movie-camera recordings);

- advice emanating from users'committees.

Identification of the previous pictogram's weaknesses and related adjustments

In its former appearance, the pictogram presents a number of weaknesses.

1- it is not sufficiently persuasive. the victim's negligence in crossing the tracks despite the illumination of the pictogram is the major causation factor for all accidents. This indicates that the pictogram is not perceived by the public as a mark of absolute danger (the same attitude is found in the road traffic).

2- it is not sufficiently visible, even if the poor visibility or lack of visibility of the pictogram is never *per se* the full explanation of the cause of a crossing accident, it contributes significantly to the occurrence of some accidents:

- under blazing sunlight, the pictogram illumination can be missed due to poor visibility;
- under heavy rain or snow , the pictogram is not looked at and is consequently not seen (people look down when they walk under such conditions);
- the pictogram is masked by a train which stands on the timber plated pedestrian crossing.

3 - its meaning is not *sufficiently transparent*:
- the message conveyed can be interpreted or diverted: some passengers think that this facility is reserved to railway staff.

Regular users tend often to remain under shelter in the station and therefore to escape from the rigour of the climate while having a pleasant chat. The illumination of the pictogram is then perceived as a signal for train arrival and as an invitation to cross tracks...

All these thoughts have been translated into the following steps:

*** improved visibility of the safety device**

- diodes substituting electroluminescent bulbs as the former are more visible under sunlight;
- introduction of a flashing aspect;
- the platform pictogram (or overhead pictogram) is now supplemented by two trackside pictograms placed in the space between the two tracks on both sides of the timber-plated pedestrian crossing.

*** improved readability of the safety device**

- the illuminated figure has a clearer posture with arms spread *indicating a standstill*;
- the « stop » mention is written under the figure.

④ PASSENGER SAFETY SIGNPOSTING

General goal to be attained:

The passenger safety signposting is meant to convey to passengers and station users (customers, accompanying persons) a number of basic safety rules;

The company tries to obtain from station users a pattern of behaviour in line with pre-established rules and sensitive to the specific requirements of the railway;

There is no point in erecting gates *to prevent platform* access during train movements but total trust in passenger self-discipline is also exaggerated;

A common CODE with its legal and moral resonances should therefore bind the company and the passenger, the former catering for passenger needs whilst the latter expects in return the passenger to comply with certain rules;

These rules are part of the overall directions for use of the transport space and attached facilities/equipment.

However, it is essential to develop a clearly separate image between the safety signing system and the other passenger information systems whilst maintaining some consistency between them:

. colours having each a specific meaning (red for standstill and keep away, yellow for warning, green for safety and emergency, orange for ticket-stamping, blue for signposting);
. vocabulary to be used (e.g. avoiding the misuse of the terms « track » and « platform » which should not be used and construed as synonyms)

. message size and form (the combination of message sizes and forms reflects their respective status and degree of priority).

Principles adopted:

a) passenger safety signposting

The information that should be conveyed via the signposting is selected by the Infrastructure Department jointly with Business Sectors, the international rules enforceable as signposting requirements being referred to and complied with.

The location rules for passenger safety signposting are also set out by Central Headquarters, a special focus being placed on two categories of « particularly-exposed » people:

*occasional users who are quite dependent on guidance signs and unfamiliar with the operating mode of the railways;

*regulars over a given site who think they know perfectly the place and facilities and pay little attention to indications and prohibitions;

The point is to be able to meet the following requirements:

- transmitting **simple and explicit** messages using the language of the customer and not that of the company;

- ensuring the visibility of these messages within the signposting device;

- prioritizing these messages according to the specific weight attributed by the company to each of them ;

- ensuring an overall consistency, irrespective of the station where the passenger is;

- ensuring a corporate image consistency thanks to the size of boards, and message forms, colours and contents.

Finally, environmental disturbances should be minimized and passenger safety signposting should not be masked , either by general purpose signposting or by advertising

Moreover, for stations where staff does not attend all the stopping trains and which therefore may be subject to varying crossing conditions, a single text shall have to address these two types of situation.

The new texts and devices are not in opposition with the previous models; they make possible swift and flexible changes to the existing equipment, as required by modification plans.

The colours used with the passenger safety signposting are those specified by the EU Directive 95/58

b) Safety messages

The safety of people in our premises is hinged on five types of message:

1. **Prohibitions** (no entry, keep out, keep away, no crossing....) which are generally preceded with the mention « DANGER ».

2 **Warnings** (keep inside the yellow strip, do not stand on the platform edge) generally preceded with the mention « FOR YOUR OWN SAFETY ».

3. Information concerning the **operation of safety devices** (e.g. the telephone).

4. **Limits of the** station **zones** which coincide with the borders in terms of responsibilities (inside or beyond the line of ticket stamping machines, for instance),

5. Information concerning the **operation of the station** (opening hours...)

c) Areas to be covered within stations

From the safety point of view, the station space may divided into two areas: the « sensitive » area where the railway activity is performed, also called « critical » area (i.e. platforms, tracks, spaces, rooms and facilities reserved to the transport staff) and the rest of the station

For each point of transit, it is necessary to identify the intersection points between these two areas and the usual passageways in order to locate the relevant information and warnings.

⑤ PREVENTION

The safety problems when crossing rail tracks present a good case for narrower co-operation between local partners in the form of prevention programmes.

a) Rail station development operations conducted under partnership

For certain sensitive sites, the company erects at its own expenses or in association with local authorities, protective fencing in order to prevent trespassing and vandalism over its facilities.

The high cost of such measures restricts their extension and it is also necessary to combat in the same time routine vandalist acts.

The situation encountered in some stations for crossing tracks elicits the negative impact from town planning decisions which have sometimes ignored the presence of the station and of the rail tracks (construction of car parks, bus stops, etc..inducing an increase in « wild » crossings of station tracks).

Development projects close to rail stations do not always involve SNCF in the consultation process, the possible impact over the operation of the rail station being neglected together with the safety of the local people.

Sensitization of external partners seems the only sensible way forward, since SNCF alone cannot face all these problems

b) Approach with the school medium

The act n°57-81 dated July 16, 1957 requires the compulsory teaching of the highway code in French schools

The educational programmes are chiefly aimed at advising youth against potential hazards. They are also made aware of the responsibilities they have towards others and towards themselves.

Little information about trains is given under such schemes.

After the accident at MERVANS late 1992, where three young girls met their death when attempting to cross tracks despite the illumination of the pictogram prohibiting track crossing, the Management of the Company has decided to intensify prevention efforts, especially among schoolchildren.

Since then, conferences have been held in schools (last form of the primary school and first form of the secondary school) on the theme « the train matters as a training matter ».

Presentations are jointly made by SNCF and « Education nationale »

Conferences are given by SNCF employees who use teaching packs and demonstration films.

In 1996, some 1,600 presentations have been made; 45,000 pupils have been sensitized.

⑥ CONCLUSION

The efficiency of technical devices requires some sustained communication efforts towards passengers using a straightforward language which explains not only the operating mode of the device, but also the reasons why it has been fitted and the modifications it has received since its initial design. Communication is therefore a constituent part of any safety device design process and not only an add-on introduced at the end of the day for sole performance-related information purposes.

International Rail Safety Conference

1997 LUCERNE

21 May - 23 May 1997
Swiss Transport Museum, Lucerne, Switzerland

Paper 9714

Stanley Robertson

Vandalism - Management of a Social Problem

Publisher
2000 International Rail Safety Conference

Schweizerische Bundesbahnen
Chemin de fer fédéraux suisses
Ferrovie federali svizzere
Swiss Federal Railways

INTERNATIONAL RAILWAY SAFETY CONFERENCE (IRSC) 1997
21 to 23 May, Lucerne / Switzerland

PAPER:	**Vandalism** **Management of a social Problem**
PRESENTED BY:	**Mr. St. Robertson** **Chief Inspector of Railways**
DATE:	**21.05.97**
SESSION:	**IV**
TIME:	**1630-1700**

TRESPASS AND VANDALISM ON BRITAIN'S RAILWAYS

S S J ROBERTSON
HM Chief Inspector of Railways
Health and Safety Executive, UK

CASE STUDIES

- scrap rail from lineside placed on track caused derailment of train - injured passengers
- upholstery set alight on train in passenger service
- 2 year-old gained access to track through fencing damaged by vandalism - struck and killed
- 13 year-old tried to train-surf - fell under wheels of train
- 5 year-old was lifted over railway fence by a friend - came into contact with a live rail

WHO SUFFERS?

- THE TRESPASSER
- RAILWAY STAFF
- PASSENGERS
- PARENTS

TRESPASS AND VANDALISM

Is it just a problem for railway operators?

TRESPASS AND VANDALISM on the railways

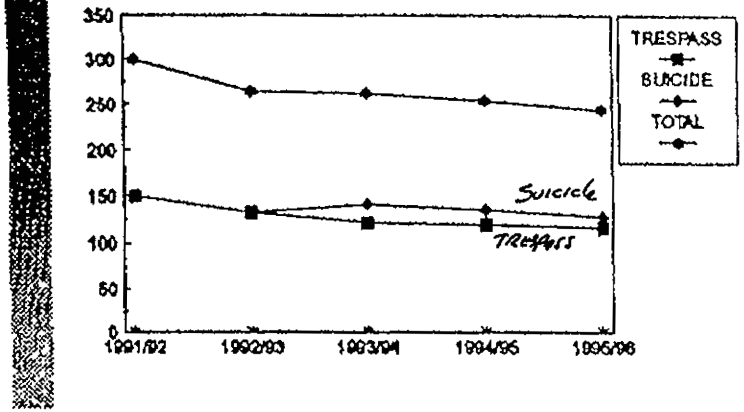
a problem for the railways

a societal problem

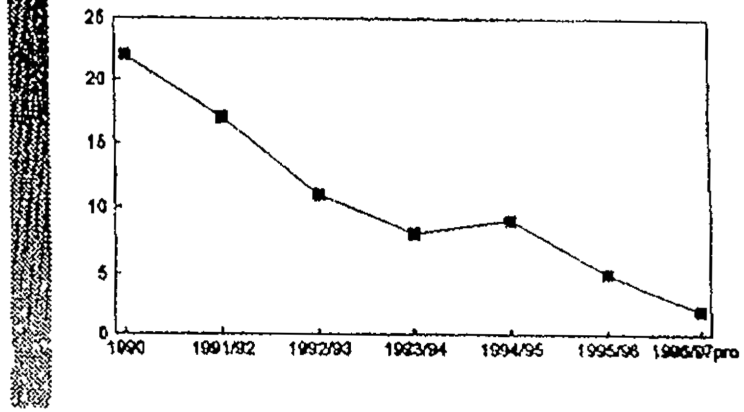
a policing problem

a parenting problem

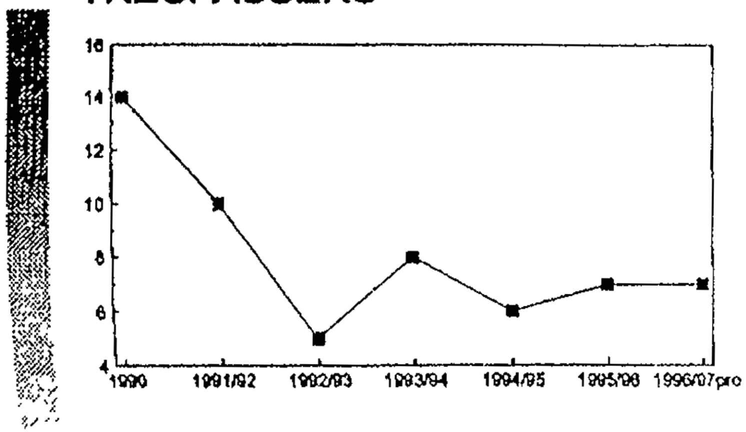
FATAL ACCIDENTS TO TRESPASSERS AND SUICIDES



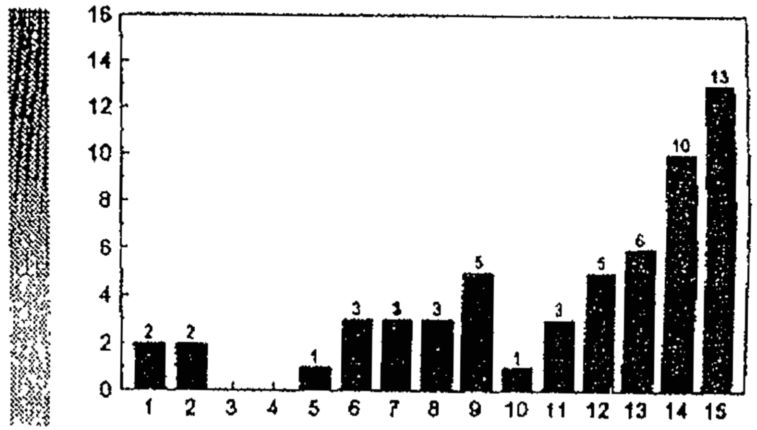
STAFF FATALITIES- all railways



FATAL ACCIDENTS TO CHILD TRESPASSERS



FATAL ACCIDENTS TO CHILD TRESPASSERS BY AGE - 1990 to date.



TRESPASS AND VANDALISM

SETTING THE SCENE

TRESPASS AND VANDALISM

"TRAIN ACCIDENTS DUE TO MALICIOUS ACTION INCREASED BY 41% FROM 228 (IN 1994/95) TO 321 (IN 1995/96)"

source: Railway Safety Report for 1995/96

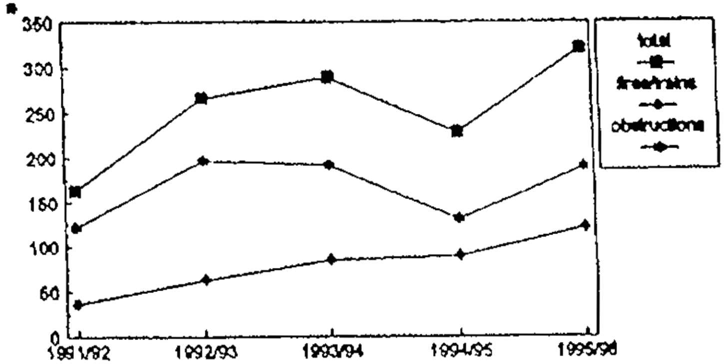
TRESPASS AND VANDALISM

% of Train accidents caused by malicious action:

1991/92	17%
1995/96	32%

source: Railway Safety Report for 1995/96

TRAIN ACCIDENTS CAUSED BY VANDALISM



ACTION POINTS FROM MARCH 1997 CONFERENCE

1. <u>Policy Statement</u> - It was agreed that a policy statement should be drawn up confirming the commitment by all participants in the conference to tackle the problem of trespass and vandalism. Participants would be asked to sign up to the statement.

ACTION POINTS FROM MARCH 1997 CONFERENCE

2. <u>Guidelines</u> - To publish a short guide or leaflet which draws together common elements from the various initiatives, setting out things to consider when addressing the problem and including case studies.

ACTION POINTS FROM MARCH 1997 CONFERENCE

3. <u>Intelligence</u> - To ensure that there is a sharing of information between all parties and that data is both consistent and up to date. This could be looked at initially by the RIAC Communications Working Group or by a new Working Group s pecifically constituted for the purpose.

ACTION POINTS FROM MARCH 1997 CONFERENCE

4. <u>Education</u> - The consideration of targeted education to be included in guidelines. The raising of the profile in the media, such as the active promotion of publicity on the hazards and effect of Trespass and Vandalism, and the possibility of a media campaign.

ACTION POINTS FROM MARCH 1997 CONFERENCE

5. Research - To consider the need for research, including consideration of the use of education

6. Legal - To discuss withthe Home Office and the Magistrates Association sentencing policy and how we could use it to act as a deterrent.

7. Local Authorities - To discuss how they feel they could be actively involved in combating trespass and vandalism on the railways.

ANTI-VANDAL AND TRESPASS MEASURES/THEMES:-

- the positive use of CCTV and other hardware (fencing etc);
- the advantages of greater human presence both on trains and at stations (in the form of British Transport Police, railway staff and the use of private security guards);

ANTI-VANDAL AND TRESPASS MEASURES/THEMES:-

- the need for education initiatives to be tailored to the intended audience;
- the importance of multi-agency approaches with sharedintelligence and co-operation. Action to be focused at a local level;
- the need for any initiatives/action to be concerted and consistent.

A. Remove the Risk

Principle 1. So far as is reasonably practicable, work should be done when trains are not running at all.

A. Remove the Risk

Principle 2. Where work must be done during times when trains are running, so far as is reasonably

a) trains should be diverted onto other tracks for the duration of the work;

b) the work site should be fenced of from any track remaining open to trains;

c) safe means of access to a separated site should be provided, separated if possible from any track in use.

A. Remove the Risk

Principle 3. Where it is not reasonably practicable to stop or divert trains, opportunities for access to the track should be provided between train movements where practicable. Methods of using those opportunities safely, by formal and recorded arrangements, supported by suitable protective measures, should be devised and installed.

B. Work in Traffic: Protective Systems

Principle 4. Where it is not reasonably practicable to separate the work from running trains, people who need to work on or near the track will need to be protected by a system that gives adequate warning of the approach of trains.

B. Work in Traffic: Protective Systems

Principle 5.

a) People who need to go on or near the track when trains are running must be fit to do so.

b) They must receive appropriate training, refreshed at suitable intervals, and comprehensive information to equip them to behave safely.

c) People with additional responsibility of others should receive additional training and carry a certificate of competency.

B. Work in Traffic: Protective Systems

Principle 6.

a) Safe means of access to the track should be provided and maintained.

b) Where people may be on or near the track open to the passage of trains, places of safety should be provided and maintained.

B. Work in Traffic: Protective Systems

Principle 7. Information from which safety on the track can be planned should be provided in a convenient and comprehensive form to everyone who needs it.

C. Safety Systems to Warn of Trains

Principle 8. Where reasonably practicable, automatic warning systems should be provided using technology of signalling-safety integrity. The use of human vigilance is an inferior approach.

Principle 9. Lookouts should, in addition to the requirements contained in Principle 5:-

a) wear a clear means of identification;
b) have reliable means of communicating warnings

C. Safety Systems to Warn of Trains

Principle 10. The safety of an individual or group at risk will need to be planned and managed by a responsible person who should in addition to the requirements contained in principle 5:-

a) wear a clear means of identification;

b) plan and write down the safe system and brief all those affected by it.

C. Safety Systems to Warn of Trains

Principal 11. The safe system of work will need to include provision of sufficient warning time to enable those at work to clear the track of obstructions and move to a place of safety.

Principal 12. On receipt of any warning, people will need to immediately move to a place of safety leaving the track safe, and acknowledging the warning.

D. Further Considerations

Principle 13. Approaching trains should be conspicuous to people on the track, and people on the track should be conspicuous to the drivers of trains, but audible warnings from trains should not be relied upon for safety.

E. Management of Health and Safety

Principle 14. Safety management principles will need to be applied to work on the track, including:-

a) planned and recorded monitoring of the correct application of the safety systems;

b) recording and investigation of accidents and near misses;

c) encouraging the reporting of near misses in a full and frank manner;

d) having systems to implement necessary changes to the safety systems revealed by any of the above.

International Rail Safety Conference

1997 LUCERNE

21 May - 23 May 1997
Swiss Transport Museum, Lucerne, Switzerland

Paper 9715

Paul Godier

Case Study: Suicides on the London Underground

Publisher
2000 International Rail Safety Conference

Schweizerische Bundesbahnen
Chemin de fer fédéraux suisses
Ferrovie federali svizzere
Swiss Federal Railways

INTERNATIONAL RAILWAY SAFETY CONFERENCE (IRSC) 1997
21 to 23 May, Lucerne / Switzerland

PAPER: Case Study
Suicides on London Underground

PRESENTED BY: Mr. P.Godier
Head of Safety & Environmental Development

DATE: 21.05.97

SESSION: IV

TIME: 1700-1730

INTERNATIONAL RAILWAY SAFETY CONFERENCE
LUCERNE
May 1997

SUICIDES ON LONDON UNDERGROUND

Paul Godier
Head of Safety & Environmental Development
LONDON TRANSPORT

Paul Godier, London Transport, Head of Safety & Environmental Development

Paul Godier is an economist by background. After 6 years with the Planning & Transportation Department of the Greater London Council, he joined the Planning Department of London Transport in 1978, undertaking investment appraisal. He then moved into operations planning, and after a short period working for British Rail he returned to London Underground and became General Manager of the Bakerloo line for 4 years. He has been the LT Head of Safety and Environmental Development since 1995.

CONTENTS

SUICIDES ON LONDON UNDERGROUND

1. EXECUTIVE SUMMARY

1.1 Each year on the London Underground there are about 30 deaths and 20 major injuries due to suicides or suicide attempts, and many more attempts or threats to commit suicide that lead to minor injury, or no injury. In addition to the harm to the victims, these incidents can traumatise others involved, especially train drivers, and lead to considerable delay to the service. Drivers face roughly a 1 in 50 chance of a suicide attempt each year. The average time off work for drivers after a suicide is 16 days.

1.2 About three quarters of London Underground Limited (LUL) suicides are by jumping from a platform into the path of a moving train. Only 5% are outside stations (compared to 80% of Railtrack suicides). Interviews with survivors indicate that only 30% have more than 3 hours pre-planning (80% of Railtrack suicides are thought to be pre-planned). Suicides on both systems are about 60% male, with an average age of 40 (considerably younger than for suicide by other means). Both Railtrack and LUL experience fewer suicides on Sundays, and the lowest month of the year is December.

1.3 Total suicidal acts on the Underground has risen from about 34 per annum in the 1940s to 94 p.a. in the 1980s. There has been a reduction in the number of suicides on both the Underground and Railtrack since 1991. On LUL there were 51 deaths and major injuries in 1992/3, but only 37 in 1995/6.

1.4 Suicide is closely associated with psychiatric illness, with more than two thirds of LUL suicides receiving some kind of psychiatric treatment. There are clusters of suicides at stations with a psychiatric hospital nearby.

1.5 LUL have started a review of suicides, and the actions that could be taken to reduce their frequency or severity. Options being evaluated include:

- infrared detection cameras at key stations;
- platform edge doors;
- closed circuit television surveillance of platforms; &
- suicide pits at key stations.

2. INTRODUCTION

2.1 In 1996 London Transport undertook an initial review of suicides on the Underground. The review covered previous studies, more recent London Underground Limited (LUL) data, and also highlighted differences and similarities in experience of suicide with the national (Railtrack) network. The emphasis of the review was to consider the number and pattern of suicides and suicide attempts; and to consider what further worthwhile measures might be taken to reduce this form of human loss

2.2 The review has been followed by a second study of the costs and benefits of specific measures to reduce suicides and suicide attempts, which is still underway. This paper summarises progress to date.

3. SOURCES OF INFORMATION

3.1 Most of the available knowledge of suicides on the London Underground system is taken from a three year study carried out by the Department of Public Health and Epidemiology at Charing Cross & Westminster Medical School (Prof. Farmer et al., October 1992)[1]. This study included data for suicides on the Underground system between 1940 and 1st June 1992, sourced from official records (based on the results of coroners' inquests), internal records held by the Underground and records held by British Transport Police. The researchers attended several coroners' inquests, interviewed 26 survivors of suicide attempts to identify patterns of behaviour and motivation, and interviewed drivers involved in suicide attempts to assess any trauma effects and possible ways of dealing with this.

3.2 In this paper, data for suicides from 1st April 1992 to the end of the reporting year on 31st March 1996 on the Underground system are also examined. These data are extracted from Incident Notification Forms (INF), but these are limited in content (for example there is very little information about the person attempting the suicide, usually only the sex being stated with no information on age, any mental illness, place of residence, nationality and so on). However, the data includes suicide attempts that resulted in major and minor injuries as well as fatalities. Some data have also been collected for thwarted and threatened suicide attempts on the system, when recorded on INFs, although these data are likely to be incomplete. A very few suicide attempts have resulted in no injuries and these are also included where identified.

3.3 Therefore, the majority of assertions in this paper about the pattern of suicides and all information about motives of those attempting suicide and the effects of suicide on drivers on London Underground are based on attempts before 1992.

4. CLASSIFICATION OF SUICIDES

4.1 All deaths on the railway system must be subject to a coroner's inquest, heard by a coroner sitting with a jury. Note that juries are not commonly required in coroners' inquests, unless the verdict is required to be reported to a government body (such as the Railway Inspectorate). There are therefore official formal records of fatalities by suicide on railways in the UK. However, fatalities which are officially recorded as suicides understate the true level of suicide on railways, because of the high standard of proof required by coroners' juries, when a verdict of suicide can only be recorded if it is proved *beyond reasonable doubt* that the victim intended to take their own life. Thus deaths which would be considered to be suicide in clinical terms often receive an 'open' or 'accidental death' verdict at inquest.

4.2 Farmer has compared the verdicts of coroners' inquests for London Underground deaths from the period 1950-65 with 1975-90 and found that the proportion of suicide verdicts for females has remained unchanged at just over 70%, whereas for males, this proportion has fallen from just over 70% to around 50% for the latter period. Indeed, in the age group 35 to 44 years, 80% of all railway deaths of females receive a suicide verdict with only 46% of males. The use of the open verdict increased for both sexes, with a particularly marked increase for males. The verdict 'accidental death' actually reduced amongst females to below 10%, whilst increasing to over 20% for males.

4.3 Suicide verdicts recorded on all UK railways between 1975 and 1989 constituted 4.5% of all suicide verdicts returned. In the Greater London area over the same period, 4.6% of suicides occurred on London Underground alone with an unknown additional number on Railtrack.

4.4 The railway industry needs to understand the true size of the suicide problem in order to make any decisions about whether to take mitigating measures.

Trauma amongst train drivers involved in suicide cases and disruption to train services are significant difficulties posed by the suicide issue. Therefore, data for 'possible' or 'suspected' suicides, including those attempts where the victim survives, are recorded in addition to the officially recorded 'suicide' verdict.

4.5 Railtrack have developed a formal set of criteria for classifying fatalities on the railway, and these 'Ovenstone criteria' are reproduced in Appendix 1. In short, there is a category of fatality labelled 'Suicide' which includes only those with such a verdict from a coroner's inquest. There is a further category 'Suspected Suicide' for which there is specific guidance, requiring a suicide note, evidence of prolonged depression, previous suicide attempts or similar evidence. Any other fatality is classified as 'Accidental'. Initially, the fatality is assigned to a likely category with a review at an appropriate later date, typically after the inquest, or whenever further information comes to light.

4.6 London Underground has not previously used such a formal classification system for suicides. A judgement is made by the staff who operate the LUL safety database, based upon the description on the Incident Notification Form. A further judgement is made for survivors as to whether the injuries received are 'Major' or 'Minor'. These judgements, made very soon after the event, are not usually reviewed at any later date unless a survivor subsequently dies. However, LUL has recently accepted the advantages of a consistent set of criteria, and has agreed to adopt a very similar approach to Railtrack.

4.7 Appendix 2 presents a summary of the data for suicides for the four reporting years 1992/3 to 1995/6 inclusive. Key observations from these data are reproduced in the following section.

5. THE OBSERVED PATTERN OF SUICIDE

General observations

5.1 The majority of suicides on the London Underground system are attempted by the person jumping in front of a moving train from a station platform. The next largest group stand on the track, either next to a platform or in a tunnel entrance, or walk towards an approaching train. A further small but significant group gain access to the track in the outer open sections and stand or lie on the track. (58% of the Underground's 392 route km are in the open). Finally, there have been some instances since 1992 of a suicide attempt by drug overdose, self-stabbing on a train, jumping from a bridge and by self-combustion on a platform.

5.2 Where data is available on the number of passengers on the platform at the time of an incident, it can be seen that suicides rarely occur from crowded platforms, rarely from deserted platforms and only 33% from platforms with more than 30 passengers. This is consistent with the data for the time of day of incidents (i.e. rarely in the 'rush hour') but reveals little other pattern (Farmer, 1992).

Suicide and location

5.3 The distribution of suicides around the Underground is uneven with clusters around stations close to psychiatric hospitals, which are even more pronounced if station traffic flow is taken into account. Many suicide victims are known to have been in-patients at these institutions. The stations which saw the most suicides after correction for passenger flows during the period 1981 to 1990 were Mile End, Tooting Bec, Archway, Ravenscourt Park and Belsize Park, all close to psychiatric hospitals. King's Cross/St. Pancras, Victoria and Euston experienced large numbers of suicides during this period, but the numbers are insignificant if passenger flows are taken into account (Farmer, 1992). The smaller numbers of suicides over the period 1992-96 make analysis of clustering less statistically significant, but many of the same stations still feature on a list of the highest numbers of suicides. This is despite the policy of 'Care in the Community', by which many of the psychiatric institutions have been replaced with small units, which have tended to be located close to the site of the hospital.

Suicide and timing

5.4 Time of day. There is no obvious correlation between the number of suicides and traffic volume on the Underground. The peak time for suicide is around 11:00 with 41% occurring between 10:00 and 16:00. However, the number of male suicides is fairly constant during the day whilst there is a clear peak for women between the hours of 10:00 and 13:00. During this period, 45% of suicides are women whereas after 22:00, only 17% are women (Farmer, 1992).

The smaller numbers for the most recent four year period do not contradict the Farmer findings and strongly support the finding related to small numbers of night-time female suicides.

5.5 Day of week. The fewest number of incidents occur on Sundays with no significant differences between other days of the week (Farmer, 1992). More recent data are even more equivocal about a correlation with the day of the week, showing no such trough on Sundays.

5.6 Time of year. The highest daily rate of suicide is seen in spring with March as the peak month. The fewest occurrences happen in December (Farmer, 1992). However, data since 1992 reveal no clear pattern and certainly no spring suicide peak. Since 1992, March has actually experienced the smallest rate of suicides.

5.7 Long term trends. The mean annual number of suicidal acts on the London Underground network increased from 36.1 in 1940-49 to 94.1 in 1980-89. (Farmer, 1992). However, there are the first signs of a decline with a reduction in the number of fatalities and major injuries combined from 51 in 1992/3 and 1993/4 to 37 in 1995/6.

6. THE SUICIDE VICTIM

6.1 Profile of suicide cases. Over the period 1950 to 1990, 64% of suicide incidents involved males (Farmer, 1992). The age distribution for suicides is similar for both sexes with the peak age band being between 25 and 34 years. The mean age for men was observed as 40.7 years and for women, 41.3 years (Farmer, 1992). The proportion of male suicides over the period since 1992 was similar at 58%.

6.2 The Farmer study included detailed interviews with 26 survivors of suicide attempts which, together with 46 coroner's reports of Underground suicides, enabled a profile of the Underground suicide to be built up.

6.3 The majority of the sample (more than two thirds) were receiving some kind of psychiatric treatment at the time of death. The psychiatric diagnosis of these cases was as follows (rounded to whole numbers):

DIAGNOSIS	NUMBER (%)
Schizophrenia	32
Depression	29
Manic-depression	6
Other	6
No Illness	18
Unknown	10
TOTAL	101

Thus, where information was available, in three quarters of cases schizophrenia or depression had been diagnosed.

6.4 Only 56% of the cases were born in England. Although there was no attempt to discover how this compared to the profile of all Underground passengers, it is unlikely that so many Underground users would be born overseas.

6.5 The employment status of the victim was available in some cases showing the following profile:

EMPLOYMENT STATUS	NUMBER (%)
Economically Active	47
Economically Inactive	30
Retired	17
Students	6
TOTAL	100

Note that 'Economically Active' includes begging and that the 'Inactive' group is dominated by in-patients of psychiatric institutions.

6.6 The marital status of victims was as follows:

MARITAL STATUS	NUMBER (%)
Single	59
Married (or cohabiting)	19
Divorced/separated	19
Widowed	6
TOTAL	103

6.7 Half of suicide victims chose the nearest Underground station to their place of residence, the hospital address being used for this purpose for in-patients. A further 22% used another station in the same or a neighbouring postal code district. A small number (7%) travelled into London by Railtrack from around the UK for their suicide attempt on the Underground.

6.8 Motive. Interviews by Farmer with twenty survivors of suicide attempts allow a description of the motives behind the use of the Underground for suicide. 90% thought that death was certain and 85% stated that they were definitely making a serious attempt to kill themselves, all of the remainder having only some doubts (other methods, particularly drug overdose, are often chosen by those who wish others to acknowledge the seriousness of their problems and expect to survive). 80% were certain that they would die even if medical attention was available. Only 30% had contemplated suicide for more than 3 hours prior to the event with 40% stating it was entirely an impulse decision with no premeditation.

6.9 This high rate of impulsive suicides suggests that removing the presence of a means of death, for example by installing platform edge doors, might prevent suicidal fatalities. It is not necessarily the case that all suicides deterred from the Underground would use another method elsewhere - some might never again be in the position of making an impulsive decision to commit suicide.

6.10 The reasons for precipitating the suicidal act were varied and complex, although there were some more common themes - loneliness and feeling they were a burden (amongst the elderly), the sudden ending of a relationship (young men) and serious psychiatric illness.

6.11 It was clear that for many (45%), usually those undergoing psychiatric treatment, their choice of the Underground as a method of suicide was partly influenced by their having had personal contact with others who had used this method (also including one former LUL guard who had experienced a suicide whilst on duty and a worker in a psychiatric hospital who had seen the bodies of those who had committed suicide on the Underground). A further 25% had learned of the Underground as a suicide method from reports in newspapers with one person stating that hearing a platform announcement of a 'person under a train' led to his choice of method. All believed that the Underground would provide a quick and certain death by a combination of electrocution and crushing. Some believed that there would be pain, but that this was overridden by the speed of death. The ease of access, wide availability and lack of necessity for any preparation were also stated as reasons for selecting the Underground. A few had considered other methods, such as drowning in the Thames, an overdose or jumping from tall buildings, but had rejected these for various reasons.

6.12 Only one interviewed survivor, who removed her shoes before jumping, behaved in any way which could distinguish their behaviour from an ordinary passenger. Some waited for one or more trains to pass before jumping, others jumped under the first train to arrive. Most of the survivors had jumped in front of trains, with one being electrocuted on trying to enter the tunnel and one being hit by a train whilst attempting to electrocute herself.

6.13 The effect of surviving. All of the interviewed survivors had expected to die and had attempted to explain their survival. All except two believed that they had survived due to divine intervention (one believed that the train was travelling too slowly, one fell before reaching his planned destination, the tunnel). Seven of the twenty survivors were happy to be alive and were determined to make the most of a 'second chance' at life. Eight were unsure of whether they would attempt suicide again. Three were still suicidal and the remaining two were very pessimistic about the future as their injuries had made their situation even worse.

6.14 It would therefore appear that increasing the survival rate of suicide on the Underground would lead to a sustained saving of life as a significant proportion of survivors are apparently 'cured' of suicidal tendencies.

7. SUICIDE AND DRIVERS

7.1 Farmer calculated that, based on 1989 figures, there was a 1 in 27 chance of an Underground driver being involved in a suicide attempt in any year. (Since then, reduced numbers of attempts, and an increase in services and hence the number of drivers, means that the chance today is reduced to about 1 in 50 per annum). The Farmer study interviewed 76 drivers involved in suicide attempts over 18 months at around one month after the attempt, with follow-up interviews at 6 and 12 months. In this sample, one driver had experienced 6 suicide attempts and many had experienced more than one. 25 of the drivers were diagnosed as suffering psychiatric illness related to the incident one month after the event, including neurotic depression, manic depression, phobic state and schizophrenic psychosis. Most suffered some symptoms of stress. 65% had some sickness absence from work with a mean over all 76 drivers involved of 16.3 days. At six months after the incident, two of 56 drivers re-interviewed were still psychiatric cases. There were no cases of delayed onset of Post Traumatic Stress Disorder (PTSD).

8. COMPARISON OF THE OBSERVED PATTERNS OF SUICIDE ON RAILTRACK WITH LONDON UNDERGROUND

8.1 General. Railtrack report[2] a marked reduction in the use of the suicide verdict since 1980. This is consistent with London Underground's finding that the use of the suicide verdict at inquest has reduced, amongst males only, in favour of accidental death and open verdicts. In order to address the increasing underestimation of suicides on the railway by official inquests, Railtrack, with the British Transport Police, have developed the more objective Ovenstone Criteria for suspected suicides (see section 4 above).

8.2 Railtrack have observed a 5% reduction in suicide and suspected suicide figures since 1991-92. The number of 'suspected suicides' is more than 50% of the number receiving a suicide verdict at inquest, and hence less than two-thirds of railway suicides are recorded as such by inquest

8.3 Time of day. The rate of suicide by time of day is fairly constant on Railtrack, except for a significant reduction at night when there are very few trains. Other than this, there is no discernible pattern and certainly no correlation with traffic density patterns. Women are proportionally less likely to commit suicide at night. London Underground also observe no correlation of timing of suicide with traffic density, but the period 10:00 to 16:00 sees more suicides. Women are also observed to be less likely to commit suicide at night by LUL.

8.4 Day of week. Railtrack observe a much lower rate of suicide on Sundays and this is also evident on the Underground. Small peaks are observed by Railtrack on Tuesday and Friday where there is no real pattern for LUL.

8.5 Time of year. London Underground see a peak in suicides in spring, something observed for all UK suicides. This is not seen on Railtrack. Both Railtrack and LUL observe fewest suicides in December, contrary to the rate for all UK suicides which is lowest in summer.

8.6 Age and sex. The age profile of railway suicides is not typical of most suicides. A majority of railway suicides are men and the average age on Railtrack is 40.6 years, (men - 39.4 years, women - 45.4 years) approximately 10 years younger than the average age for all suicides. The mean ages for London Underground suicides are 40.7 years for men and 41.3 years for women, and hence the pattern by age is similar for all railways

8.7 Psychiatric state of suicide. Both Railtrack and LUL have observed that most of those attempting suicide had previously undergone some psychiatric treatment.

8.8 Degree of preparation Railtrack report that at least 80% of suicide attempts on their system are 'pre-determined'. A maximum of 20% of such attempts can be described as 'impulsive'. London Underground suicides are much more likely to be impulsive (40%) with only 30% having more than 3 hours of preparation. The differences are consistent with the chosen method - most LUL suicides are carried out by jumping in front of a moving train from a station platform. On the Railtrack system, most are on open track and would require 'trespass' onto railway premises, something which would require some prior intent and preparation.

8.9 Both London Underground and Railtrack suicides are characterised by the serious intent of death of those making the attempt. In many suicide methods, notably by drug overdose, the intention is often a 'cry for help' rather than a sincere wish to end life. Jumping in front of a train could not be seen as a 'cry for help'.

8.10 Method. As stated above, the chosen method of suicide is different on Railtrack and the Underground. On Railtrack, 50% are observed to be standing or lying on the line with a further 20% found dead on the line who were probably using the same method but were not observed. 65% occur on the open line with 20% in stations. Almost all Underground suicides occur in stations with jumping in front of a moving train being the most common method.

8.11 Location. Railtrack observe no particular 'hot spots' for incidence of suicide with no location having more than four incidences of suicide in 4.5 years. In contrast, Underground suicides have been strongly concentrated around psychiatric institutions and major Railtrack termini (Euston, Victoria & King's Cross, although the termini are insignificant if passenger flows are taken into account). There is evidence of a small number of people who travel to London by train specifically for the purpose of committing suicide on the Underground.

8.12 Drivers. Railtrack have calculated that 4 out of 10 drivers can expect to witness a suicide at some time during their career. The probability of an Underground driver witnessing a suicide has been calculated at 1 in 27 per year, a higher rate than on Railtrack if an average driving career is longer than 10 years.

9. REDUCING SUICIDE ON THE UNDERGROUND

9.1 Publicity. Some research has shown that media coverage of suicides has an effect in the choice of suicide method. In particular, a German study revealed an increase in suicide on the railways following the portrayal of such an incident in a television drama. A study of newspaper reports of Underground suicides and the rate of such suicides during the week following the report revealed no statistically significant relationship (Farmer, 1992).

9.2 It is clear from the interviews with survivors that a primary reason for using the Underground for suicide was the perception of certain death. However, the chance of survival is actually around 45%, and hence it has been suggested that publicity of this mismatch between perception and reality might reduce the incidence of suicide on the Underground. However, Farmer warns against this approach for two reasons:

- The publicity is likely to suggest the Underground to those who had not considered this method previously.
- Many people who commit suicide are ambivalent about their own lives and are attracted to situations where their survival

is left to 'fate'. For those with this 'Russian Roulette' approach, publicity of a 50% survival rate is likely to encourage them to attempt suicide on the Underground.

9.3 Suicide pits The 'suicide pit' is a channel several feet deep between the running rails which is present at some stations on some lines. Although the true reason for its presence is not clear, the probability of survival of suicide attempts is higher when the pit is present, as illustrated in the following percentage figures (Farmer, 1992):

Outcome (%)	NO PIT	PIT
ALIVE	34	55
DEAD	66	45

Farmer calculated that the provision of suicide pits on all stations over the period 1973 to 1990 would have saved 161 deaths based on the above survival rates.

9.4 Area of platform. For those jumping in front of trains, the position on the platform is crucial as the speed of the train reduces rapidly as the train passes along the platform on entering the station. For those jumping from the first third of the platform with respect to the direction of travel of the train, 68% died. This reduces to 48% for the middle third and 27% for the final third.

9.5 In order to identify more closely what measures, if any, would be worth taking to reduce suicides and suicide attempts, LT has commissioned a further study, involving the help of consultants. The approach has been to "brainstorm" possible remedies with knowledgeable staff and managers, and to then undertake a cost-benefit analysis of the most promising measures. There is some debate about the appropriate statistical value of a fatality avoided, where suicides are concerned. Some would argue that a lower value should be used than for other deaths. In the first instance the LT analysis will use the same value as it employs for evaluating options to reduce high accident risks (£3.3m). In due course the sensitivity of the result to other, lower, values will be tested.

9.6 There are essentially two types of action to affect suicide. Options are:

- **Prevention** - steps to reduce the chance of a suicide attempt occurring at all; and
- **Mitigation** - to minimise the consequences, once an attempt is made.

The options that are now being examined are predominantly the latter category, and are as follows:

Yellow lines marking "no standing" areas along the platform edge - to encourage passengers to stand at least, say, 1m back from the edge of the platform, enforced by platform staff and public address announcements.

Infrared cameras that identify persons on the track at targeted "hot spot" stations - perhaps linked to train braking and video recording systems.

Platform edge doors - as fitted on many other systems, and the Jubilee line extension

Closed circuit television (CCTV) on the first part of the platform, where the train is at its fastest.

Suicide pits - as described in para. 9.3 above.

Improved liaison with emergency services - Existing co-operation between the emergency services and LUL could be further improved with simulated exercises, etc.

10. CONCLUSIONS

10.1 The most common method by which suicide attempts are made on the Underground is by jumping from a platform into the path of a train.

10 2 Most Underground suicides are undergoing psychiatric treatment at the time of their attempt and can therefore be seen as ill. This illness might be treatable and hence the life is likely to be worth saving. Further, a significant proportion of those who survive Underground suicide attempts seem to be 'cured' of their wish to end their lives, at least for a time.

10.3 As well as the human loss of those who commit or attempt suicide, they are expensive for London Underground, in terms of service delays, and to the employees of the Underground, particularly drivers, who are likely to suffer some psychiatric illness and sickness absence.

10.4 For both of the above reasons, London Underground should take those steps that are reasonably practicable to reduce the significant problem of suicides. Railtrack have suggested that the most cost efficient way to reduce railway suicide is to fund further treatment of psychiatric illness, although some general advertising and counselling availability might also be made available at reasonable cost. Railtrack are thus pursuing counselling/advice facilities at places like main line termini (Kings Cross, Victoria, etc), and have worked with the Samaritans to provide and advertise such help. On the Underground, this could be targeted at observed 'hot spots', which do not appear to exist on the Railtrack network.

10.5 Potential suicides do not generally exhibit behaviour which would allow them to be detected before the event by staff, but staff vigilance is nevertheless appropriate.

10.6 Because of the importance of the problem, care in the collection and handling of suicide data is needed. The data provided from Coroner's Inquests will always underestimate the true level of suicide on the Underground. At the Inquest, a fatality is not considered a suicide unless it can be shown 'beyond reasonable doubt' that the person tried to take their own life. Further, approximately 50% of all suicide attempts on the Underground do not result in death and hence are not the subject of an Inquest. Thus, only London Underground (and possibly the British Transport Police) is in a position to record the true extent of suicides on the Underground system. A more formal system, similar to the 'Ovenstone Criteria', has now been adopted by LUL to improve the recording of suicides.

10.7 The pattern of suicide on London Underground is different from that seen on the Railtrack network. Railtrack suicides are characteristically pre-planned and occur on the track between stations. On the Underground, suicides might be either pre-planned or impulsive (i e. the person did not enter railway premises in order to commit suicide, but committed suicide nonetheless) and occur predominantly by jumping from platforms into the path of a moving train.

10.8 A range of options to reduce the frequency or severity of suicide attempts are now under investigation by London Transport.

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ACKNOWLEDGEMENTS

This paper is based on the work of Stuart Burnett, Analysis and Assessment Section, LT Safety & Environmental Development. Thanks are also due to Dr Blair Crichton, LT Occupational Health, and Ken Flack, LUL Loss Control section, who provided information and assistance for the completion of this report. Finally, I am grateful to Railtrack for access to the findings of their study.

APPENDIX 1

APPLICATION OF THE 'OVENSTONE CRITERIA' WITHIN RAILTRACK

Railtrack have calculated that one-third of all railway fatalities (about 250 per year) receive a suicide verdict at Coroner's Inquest. However, they have estimated that a further one-third are also suicides and these are recorded as 'Suspected Suicides' using systematic 'Ovenstone criteria' to try to achieve consistency. The Ovenstone Criteria are summarised in the following.

Unless there is evidence that a death was accidental, any one of the following is sufficient for the 'suspected suicide' category:

- A suicide note.
- A clear statement of suicidal intent to an informant.
- Behaviour demonstrating suicidal intent.
- Previous suicide attempts.
- Prolonged depression.
- Instability - breakdown or evidence of failure to cope, marked emotional reaction to recent stress.

Every railway fatality receives one of three classifications:

1. 'Suicide' - coroner's verdict only.
2. 'Suspected Suicide' - one or more of above criteria.
3. 'Accidental' - all others with no evidence for either suicide category.

A category is entered at the earliest opportunity after death. This is then reviewed whenever any new evidence becomes available, particularly during any investigations and during and after coroners' inquests.

The judgement of category is made based on all available information from train drivers, eye-witness accounts, British Transport Police findings and coroners' findings. Data collated by this method is wholly for internal use within Railtrack and the BR successor companies (it will not necessarily be the same as that in the public domain).

The guidance notes also include warnings about what does NOT indicate suicidal behaviour, namely:

- Alcoholic or drug addict.
- Mental illness, unless known to be related to suicidal behaviour.
- Incurable disease.
- Trespassing.
- Under influence of drugs or alcohol at time.

Location might be an indication of suicide and age of children might give some aid - the younger the child, the less likely is suicide.

After coroner's verdicts, entries should be amended where necessary:

If SUICIDE, alter any 'suspected suicide' or 'accidental' to suicide.

If OPEN, do not alter the entry unless evidence at the inquest suggests a different category. The verdict itself should not result in category change.

If ACCIDENTAL or MISADVENTURE, re-categorise any suicide category as 'accidental', unless local management have overwhelming reason to believe the death was suicidal.

APPENDIX 2

LONDON UNDERGROUND SUICIDE ATTEMPTS SINCE 1991

The data examined in this Appendix is taken from LUL Incident Notification Forms (INFs).

The initial aim was to uncover details of all of the events reported as 'Suicide' (or equivalent category then in use) in the LUL Safety Performance Report, thus including all of the 'Minor Injuries' as well as the fatalities and 'Major Injuries'. However, in the time available, not all of the minor injuries have been identified, whilst several other INF entries relating to suicide which did not result in injury (and were not therefore formally reported) were discovered. These data are not complete, but do provide a useful set of data from which to examine patterns of suicide on the Underground over four years, covering the period since the end of the Westminster Hospital Study in 1992 (Farmer et al). The extra suicide entries are in three forms:

- The very few actual suicide attempts which resulted in no injury, apparently after being struck by a train ('No Injury').
- Suicide attempts where there was an obvious attempt to commit suicide, usually either a person on the track with suicidal intent, but the train was able to stop in time to prevent injury, or a person prevented from jumping in front of a train by the actions of staff or passengers. These are classified 'Attempts'.
- The final group is of a small number of persons who declare suicidal intent, but no act has taken place. These are typically persons who are questioned by staff

after being observed to be behaving strangely, and then declaring that they intend to commit suicide. It is known that there exists a significant group who declare the intent, or even commit, suicidal acts as a 'cry for help', typically by taking an overdose of paracetemol or other widely available medicinal drug, knowing that they will be 'rescued' before death. Persons in this group, labelled 'Threaten', are treated as a separate category as there are doubts as to whether the intent to commit suicide is genuine. Jumping in front of a train could not be seen as a 'cry for help' as the perceived chance of survival is zero (the actual probability of survival is a good deal higher).

The year by year figures since 1991 are:

YEAR	FATAL	MAJOR	MINOR	ATTEMPT	THREAT
1991-92	**33**	**13**	**1**	**n/a**	**n/a**
1992-93	**29**	**22**	**11**	**18**	**2**
1993-94	**34**	**17**	**7**	**17**	**4**
1994-95	**27**	**17**	**6**	**12**	**5**
1995-96	**22**	**15**	**4**	**10**	**5**

The columns 'Major' and 'Minor' refer to major and minor injuries. 'Attempt' is the number of real attempts at suicide which were thwarted either by a train successfully stopping before hitting a suicide or by the suicide being prevented from jumping in front of a train by a member of staff or public. 'Threat' represents those cases where a person has been brought to the attention of a member of staff or the Police and who claim they intend to commit suicide. Data in the last two categories are incomplete in all years and were not collected for 1991-92.

The fact that only one minor injury is recorded for the whole of 1991/92, suggests that there has been a change in definition, or else the data set for that early period is incomplete.

ANALYSIS OF DATA

The data studied in this Appendix are for the four complete reporting years of 1992-93 to 1995-96 and include 284 incidents, from all of the categories defined above. This time period is approximately that since the completion of the Farmer report on Underground suicides (for which the data set ended in June 1992).

- <u>Number per year.</u>

  The number of fatalities and major injuries per year has fallen since 1992-93. It is not known if this is due to any mitigating actions taken after the Farmer report or even if the reduction is statistically significant or sustainable.

YEAR	FATAL	MAJOR	TOTAL
1992-93	29	22	**51**
1993-94	34	17	**51**
1994-95	27	17	**44**
1995-96	22	15	**37**

- <u>Distribution by Day of Week</u>

  There is no clear pattern of suicides by day of the week over the period 1992/3 to 1995/6 (including all fatalities, injuries, attempts and threatened attempts). Other studies have revealed a clear trough in suicides on Sundays.

DAY	NUMBER
Monday	47
Tuesday	36
Wednesday	29
Thursday	54
Friday	40
Saturday	23
Sunday	34
Unknown	21

- Distribution by Time of Day

There is no clear pattern with the number of suicides and the time of day, suggesting no relation to traffic. The only observation is that there are relatively few suicides before 9 a.m. and that there are none during the night hours when stations are closed and there is very little traffic on the railways.

TIME	NUMBER	TIME	NUMBER
00:00 to 00:59	5	12:00 to 12:59	12
01:00 to 01:59	1	13:00 to 13.59	7
02.00 to 02:59	0	14:00 to 14:59	9
03:00 to 03:59	0	15:00 to 15:59	8
04 00 to 04 59	0	16 00 to 16:59	11
05.00 to 05:59	1	17.00 to 17 59	9
06:00 to 06.59	4	18:00 to 18.59	11
07:00 to 07:59	4	19:00 to 19:59	9
08:00 to 08:59	5	20.00 to 20:59	8
09 00 to 09:59	14	21.00 to 21 59	5
10:00 to 10:59	4	22:00 to 22:59	7
11:00 to 11:59	10	23:00 to 23 59	12

There are 128 incidents where the time has not been identified.

Previous studies have noted the relatively small number of females who attempt suicide late at night. The distribution by sex was therefore examined for the period 22:00 to 02:00 and compared with the distribution between 10:00 and 14:00.

TIME	unknown	MALE		FEMALE	
22 00 to 01.59	2	16	70%	7	30%
10 00 to 13 59	1	13	41%	19	59%

These data confirm previous findings that females are much less likely to attempt suicide late at night.

- Distribution by Period

The variation of number of suicides per period is shown in the following table. The length of period varies slightly, and hence a further column showing the number of suicides per day in each period is calculated.

4 WEEKLY PERIOD	NUMBER OF SUICIDES	PREDOMINANT MONTHS	MEAN PERIOD LENGTH (days)	NUMBER PER DAY *
1	19	April	26 0	0 73
2	21	April, May	27.0	0 78
3	22	May, June	27.0	0 82
4	26	June, July	27.0	0 96
5	26	July, August	27 0	0 96
6	20	August, September	27 0	0.74
7	16	September, October	26 75	0.60
8	27	October, November	27 25	0.99
9	28	November, December	27.0	1 04
10	18	December, January	27 0	0.67
11	24	January	27 0	0 89
12	21	February	27.0	0 78
13	16	March	29.25	0.55

* The number of incidents in that period over the four years studied, divided by the mean number of days in that period.

There appear to be peaks in these data at periods 4 to 5 (June, July, August) and periods 8 to 9 (late October to early December). The lowest numbers of suicides occur in periods 7 (September and early October) and 13 (March). This is contrary to previous studies on the Underground which identified a suicide peak in spring, particularly in March.

- <u>Distribution by Season</u>

Seasons were deemed to begin on the 21st day of March, June, September and December. The number of suicide incidents in each season was:

SEASON	NUMBER
Spring	58
Summer	73
Autumn	83
Winter	58
date unknown	12

The results contrast with some previous studies, including Farmer, which have shown a peak in spring suicides.

- <u>Distribution by Location</u>

This study identified 265 suicide incidents with known locations during the four year period covered. These took place at 134 different stations with a maximum of 7 incidents at any one station. Those locations with 4 or more incidents during the period studied (1992/3 to 1995/6 inclusive) were:

Tooting Broadway	7
Victoria	7
East Ham	6
Wood Green	6
King's Cross	5
Paddington	5
Bethnal Green	4
Clapham South	4
Euston	4
Kennington	4
Mile End	4
Northwick Park	4
Piccadilly Circus	4
Swiss Cottage	4
Tooting Bec	4
Upton Park	4

Many of these stations are those which were identified by Farmer as having a high level of suicide incidence. When passenger throughput is taken into account, the location of clusters around stations close to psychiatric institutions is even more evident.

- Distribution by Line

The survival rate of suicide attempts varies between the lines. For the following data, suicide attempts involving Circle Line trains are included with figures for either the District or Metropolitan Lines, as appropriate. The numbers attempting suicide on each line, together with a breakdown of the level of 'success' of the attempts, is shown in the following with percentage 'success' levels in brackets (percentage of all fatalities, injuries and attempts, excluding 'threats'):

LINE	NUMBER	FATALITY	MAJOR	MINOR	ATTEMPT	THREAT
Bakerloo	22	*7*(32%)	*9*(41%)	*1*(5%)	*5*(23%)	-
Central	31	*11*(38%)	*10*(34%)	*2*(7%)	*6*(21%)	*2*
District	36	*15*(47%)	*5*(16%)	*2*(6%)	*10*(31%)	*4*
East London *	2	*1*	*1*	-	-	-
Hammersmith	7	*2*	*1*	-	*4*	-
Jubilee	8	*7*(88%)	-	-	*1*(12%)	-
Metropolitan	25	*12*(52%)	*3*(13%)	*1*(4%)	*7*(30%)	*2*
Northern	62	*21*(37%)	*22*(39%)	-	*14*(25%)	*5*
Piccadilly	45	*24*(56%)	*9*(21%)	*2*(5%)	*8*(19%)	*2*
Victoria	25	*12*(50%)	*8*(33%)	*2*(8%)	*2*(8%)	*1*
unknown	21	-	*3*	*18*	-	-
TOTAL	284	*112*(42%)	*71*(26%)	*28*(10%)	*57*(21%)	*16*

* The East London Line was closed for much of the period studied here.

Note that the relative lack of information about minor injuries leads to overestimates of the proportion of fatalities and major injuries on each line.

Thus, there is a clear variation in the proportion of survived suicide attempts between the lines. One explanation for this difference could be the differences in provision of 'suicide pits', there being a good correlation between high survival probability and suicide pits in the Farmer report.

LINE	'SURVIVAL RATIO' *	PROPORTION OF SUICIDE PITS
Bakerloo	56%	*60%*
Northern	51%	*70%*
Central	48%	*37%*
Victoria	40%	*100%*
Piccadilly	27%	*57%*
District	25%	*0%*
Metropolitan	20%	*0%*

* *Defined as major injuries divided by (major injuries plus fatalities). Other data for minor injuries and attempts is incomplete. The Jubilee, East London and Hammersmith & City Lines are excluded due to lack of data.*

There is not a good correlation here, except that the two worst lines for survival are those without suicide pits, the District and Metropolitan. A more sophisticated analysis matching the station location of the attempt with the provision of suicide pits and including minor injuries might improve the correlation.

- <u>Distribution of suicides by chosen method</u>

Almost all suicides on the Underground involve the person attempting to be hit by a moving train. The predominant method is by jumping from a platform into the path of a moving train ('Jump') with most of the balance involving the person standing, sitting or lying on the track at a station ('On Track') awaiting the arrival of a train. The numbers attempting suicide by each method, together with a breakdown of the level of 'success' of the attempts is shown in the following with percentage 'success' levels in brackets (percentage of all fatalities, injuries and attempts, excluding 'threats'):

METHOD	NUMBER	FATALITY	MAJOR	MINOR	ATTEMPT	THREAT
Jump	176	*96* (55%)	*54* (31%)	*5* (3%)	*18* (10%)	*3*
- additional probable jump	11	-	-	*1*	*2*	*8*
On Track (in station)	39	*9* (24%)	*4* (11%)	*3* (8%)	*21* (57%)	*2*
- additional probable on track	1	-	-	-	*1*	-
Either Jump or On Track	14	*5*	*7*	*1*	*1*	-
On Track (between stations)	6	-	-	-	*6*	-
Cutting wrists/stabbing	4	-	-	*1*	*3*	-
Jumping from Bridge	2	-	*2*	-	-	-
Drug Overdose	2	-	-	-	*2*	-
Climb between cars at station	1	-	-	-	*1*	-
Jump from between cars in tunnel	1	*1*	-	-	-	-
Set self alight	1	-	*1*	-	-	-
not identified	26	*1*	*3*	*17*	*2*	*3*
TOTAL	284	*112* (42%)	*71* (26%)	*28* (10%)	*57* (21%)	*16*

These numbers reveal the predominance of Underground suicide attempts from station platforms. Standing or lying on the track is far less likely to result in death or injury with 57% of such attempts being thwarted, either by the actions of station staff or because the driver was able to stop in time to avoid hitting the person. In contrast, 86% of suicide attempts by jumping resulted in major injury or fatality.

It is interesting to note that 21% of serious suicide attempts were thwarted by the actions of staff or passengers, an underestimated figure since it is likely that there are more similar unsuccessful suicide attempts which were not identified in this study. The overall rate of fatality is 53% as a proportion only of those attempts which result in at least minor injury.

There are differences in the likelihood of use of the different methods by sex:

METHOD	NUMBER	MALE	FEMALE	unknown
Jump	176	*101* (58%)	*74* (42%)	*1*
- additional probable jump	11	*6*	*5*	-
On Track (in station)	39	*17* (47%)	*19* (53%)	*3*
- additional probable on track	1	-	*1*	-
Either Jump or On Track	14	*10*	*3*	*1*
On Track (between stations)	6	*6*	-	-
Cutting wrists/stabbing	4	*2*	*1*	*1*
Jumping from Bridge	2	*2*	-	-
Drug Overdose	2	*2*	-	-
Climb between cars at station	1	*1*	-	-
Jump from between cars in tunnel	1	*1*	-	-
Set self alight	1	*1*	-	-
not identified	26	*2*	*2*	*22*
TOTAL	284	*151* (59%)	*105* (41%)	*28*

Thus 59% of those who attempted suicide on the Underground were male, a proportion also seen amongst the largest group by method, jumpers. However, a majority (53%) of those who attempt suicide by climbing onto the track and standing, sitting or lying in front of a train are female.

International Rail Safety Conference

1997 LUCERNE

21 May - 23 May 1997
Swiss Transport Museum, Lucerne, Switzerland

Paper 9716

Johan de Villiers

The principles of safe movement on rail (POSMOR) and Safety Management for the Future

Publisher
2000 International Rail Safety Conference

Schweizerische Bundesbahnen
Chemin de fer fédéraux suisses
Ferrovie federali svizzere
Swiss Federal Railways

INTERNATIONAL RAILWAY SAFETY CONFERENCE (IRSC) 1997
21 to 23 May, Lucerne / Switzerland

PAPER:	**Safety Management** **The Principles of Save Movement on Rail (POSMOR)** **and Safety Management for the Future**
PRESENTED BY:	**Mr. Johan de Villiers** **Senior Manager**
DATE:	**22.05.97**
SESSION:	**V**
TIME:	**0830-0900**

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 organisation.

Johan gained experience 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 with the structuring of a Risk and Quality department within the new two-stream railway.

~•~

THE PRINCIPLES OF SAFE MOVEMENT ON RAIL (POSMOR) AND SAFETY MANAGEMENT FOR THE FUTURE

1. INTRODUCTION : The changing scene

South Africa is experiencing fundamental changes which affects all walks of life

The changes are dynamic, intended to shape the South African democratic political future, and create a new global roleplayer More health and safety based legislature has been passed since the new Government came into power in 1994 than that which existed since 1910

Most of the parastatal organisations, such as Spoornet, are caught up in the process with few options but to deal with the effects

Imbalances are mainly caused by the rapid and dramatic changes enforced by the new Government, the simultaneous drive to become a business oriented railway and to be profitable with almost immediate effect.

The railway safety atmosphere is one of uncertainty, instability and insecurity By accepting this destabilized safety environment as a challenge, a system was developed and is in the process of becoming the foundation on which future railway safety will be constructed.

1 1 Under normal conditions the slow changing processes will include the development and deployment of new railway related acts, amendment to existing acts and development to / implementation of legislative regulations, protocols and other governmental arrangements. These relatively slow changes give rise to the natural evolution of train working rules within the company These rules adapt to changes rapidly In a business driven environment the rate of change within the company is even more rapid in response to business requirements

The equilibrium between the elements with rapid change and those of slow change (i e the stable elements) is severely disturbed if the "slow" side also undergoes drastic change. A typical example can be illustrated by the political changes that South Africa has recently experienced. The one dispensation was unseated after 48 years of reign Almost every part of legislation now comes under scrutiny and dramatic and rapid changes are experienced

The effect of this rocks the safety boat severely.

SPOORNET

1.2 Safety instability is aggravated by periodical *total and radical restructuring* of Spoornet Spoornet is changing from a people-intensive decentralized organization to a centralized automated computer driven system This implies that vast numbers of employees will either be transferred to other locations or will have to leave the service

The human reaction to these factors is to concentrate on own survival As a result special efforts are required to draw full attention back to the managing of operational risks/losses

1 3 The third destabilizing factor for South Africa's railway safety is the process of *concessioning* Sections of the existing (80 + years old) railway system will, in the near future, be available for sale / lease The idea that future competition will not exclusively come from road hauliers but also from other railway operators is foreign to the South African scenario and is perceived by many as another threat

Safety again suffers

1 4 If a 'helicopter' view is used to understand the process of legislating and regulating a railway, two "channels" of control over safety related activities can be identified

* On the one hand government is the driver of the control process and

* on the other the company's internal arrangements give impetus to the change scenario

Relative to each other these channels of control change over time at different tempo's:

FIGURE I

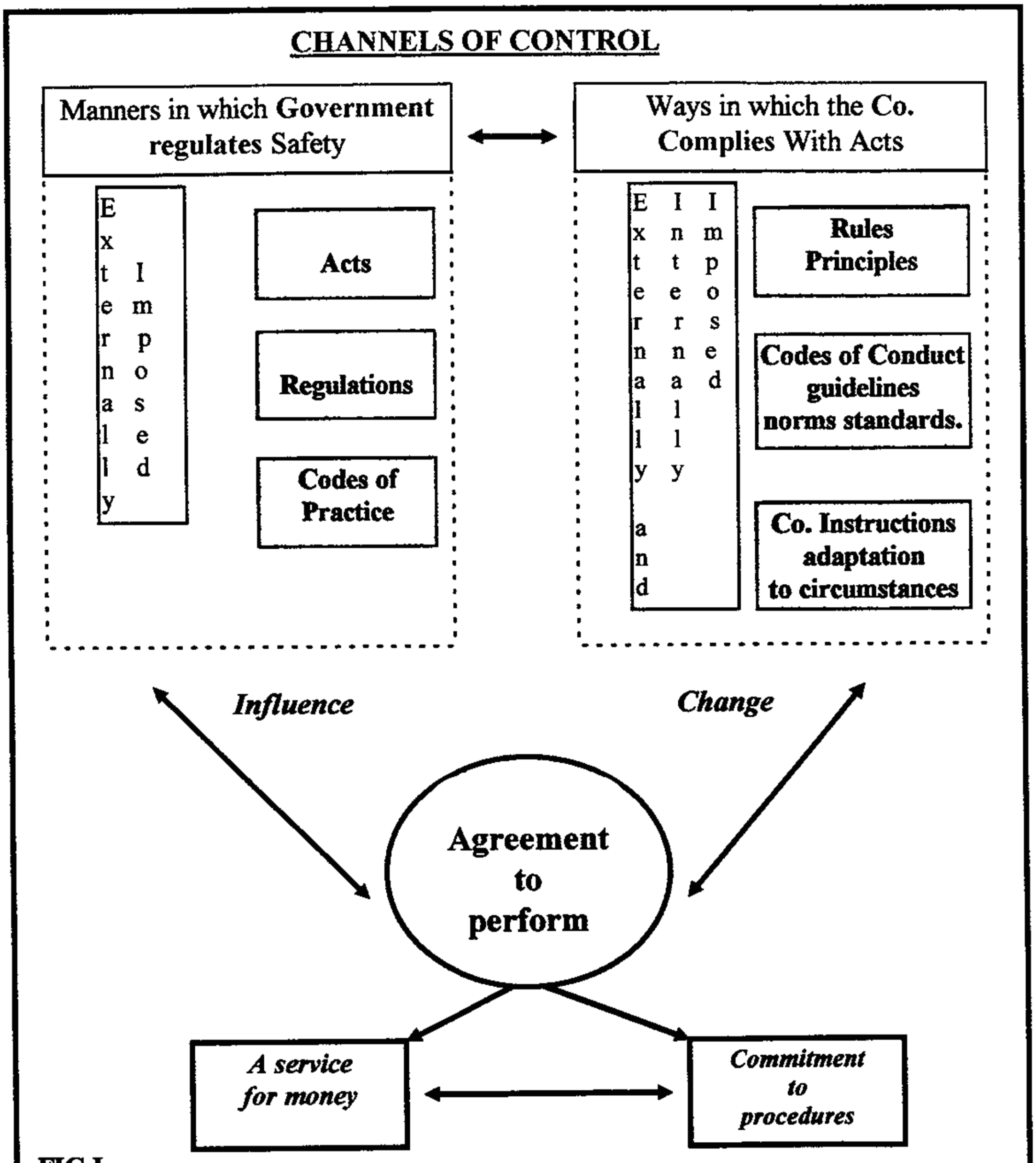
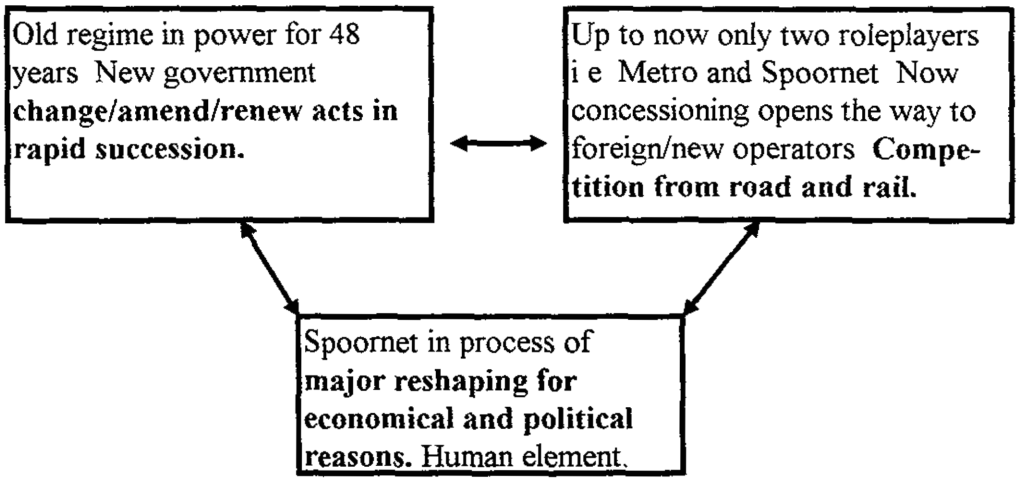


FIG.I

1 5 The safety stability triangle in the South African scenario can be illustrated as -

FIGURE II

THE RAILWAY SAFETY STABILITY TRIANGLE



Note **If all three corners of the safety triangle are unstable the possibility of a complete collapse becomes very real.**

FIG.II

2. VALUES TO STABILIZE THE SAFETY TRIANGLE :-

Under the circumstances, as described in paragraph 1, Spoornet had to find other values to recreate stability which will withstand the strong winds of change These values should serve as the foundation on which to build a future safety strategy. It had to be accepted by all parties and be rigid enough to be stable in present and future dynamics of change as well as possible destabilizing technological influences.

A task group, The Safe Rail Management System Committee (SRMSC), was appointed to develop the foundation for future railway operating safety

2.1 THE PROCESS TO REINSTATE SAFETY STABILITY :-

The SRMSC proposed a set of critical assumptions as the departure point for railway safety. These critical assumptions were intended to set the scenario for the next phase i.e to decide on the absolutes that will represent the beliefs that every railway operator will have to abide by.

2.1.1 CRITICAL ASSUMPTIONS :-

The following critical assumptions were made in order to define the expected future scenario within the company -

* All railway operators shall be law abiding despite rapid and sometimes drastic and sudden changes

* All railway operators shall accept the social responsibility emanating from it's activities

* Safety is always relative and can only be measured in practical values

* Actions / activities of railways must be able to withstand the test of the reasonable man

* Railway rules are under all circumstances, compulsory and enforceable. Management cannot exempt themselves by "hiding" behind safety rules

* Cost cannot be the final arbiter of risk. Safety always has a price. Trade-off's will be necessary.

* Employees will always act in the best interest of the individual organization

FIGURE III

CRITICAL ASSUMPTIONS

* Be law abiding
* Accept social responsibility
* Safety must add practical value
* Withstand test of reasonable man
* Company rules compulsory and enforceable
* Safety has a price
* Employees will act in best interest of company

FIG.III

2.1.2 THE FOUR ABSOLUTES

Within the framework of the accepted critical assumptions the following absolute values were developed -

Assurance :-

For the past 75 years Spoornet was the only railway operator in South Africa Anticipating the changes i e that more operators will emerge, assurance is sought that all role players will be forced to comply in all respects to accepted and set standards and procedures

Accountable :-

All parties i e all railway operators, infrastructure owners and Government must be willing and able to be held fully accountable for their actions and the influence of their actions on other role players

Adherence :-

Irrespective of who is involved and irrespective of the reasons for, or the physical location and nature of involvement, every role player and/or employee representing a role player shall adhere to valid instructions/orders

Adapt :-

Railway operators shall take timeous and appropriate measures to manage and adapt to abnormal and/or changing circumstances with the minimum of spillover effects into other parties activities

All roleplayers i e Spoornet, Government and future concessionaires will have to abide by these absolutes under all circumstances.

These absolutes are known as "The 4-A's

FIGURE IV

THE FOUR ABSOLUTES

1. **Assurance** - the enforcement of multi-way compliance, by all role players, according to standards and procedures

2. **Accountable** - all parties involved are to accept full accountability for their actions.

3. **Adherence** - compliance by all and to all valid instructions/orders

4. **Adapt** - taking timeous and appropriate measures to suit abnormal or changing circumstances.

FIG.IV

2.1.3 PRINCIPLES OF SAFE MOVEMENT ON RAIL :-

With the framework of "critical assumptions" and the "absolutes" the scene was set for the SRMSC to develop the "Basic principles of safe movement on rail (POSMOR)"

These principles were discussed at previous International Safety Conferences but for the sake of completeness are repeated ·

2.1.3.1 PRINCIPLES OF SAFE MOVEMENT ON RAIL (POSMOR)

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 of 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.

NOTE:- Attached to this script is a policy document furnishing more detail on the principles.

3. A NEW STABILITY

Triangular stability is recreated by adding these strong stable factors i.e principles based on absolute values and within a frame of accepted critical factors

The scene is set to build future safety scenarios on a rigid basis

FIGURE V

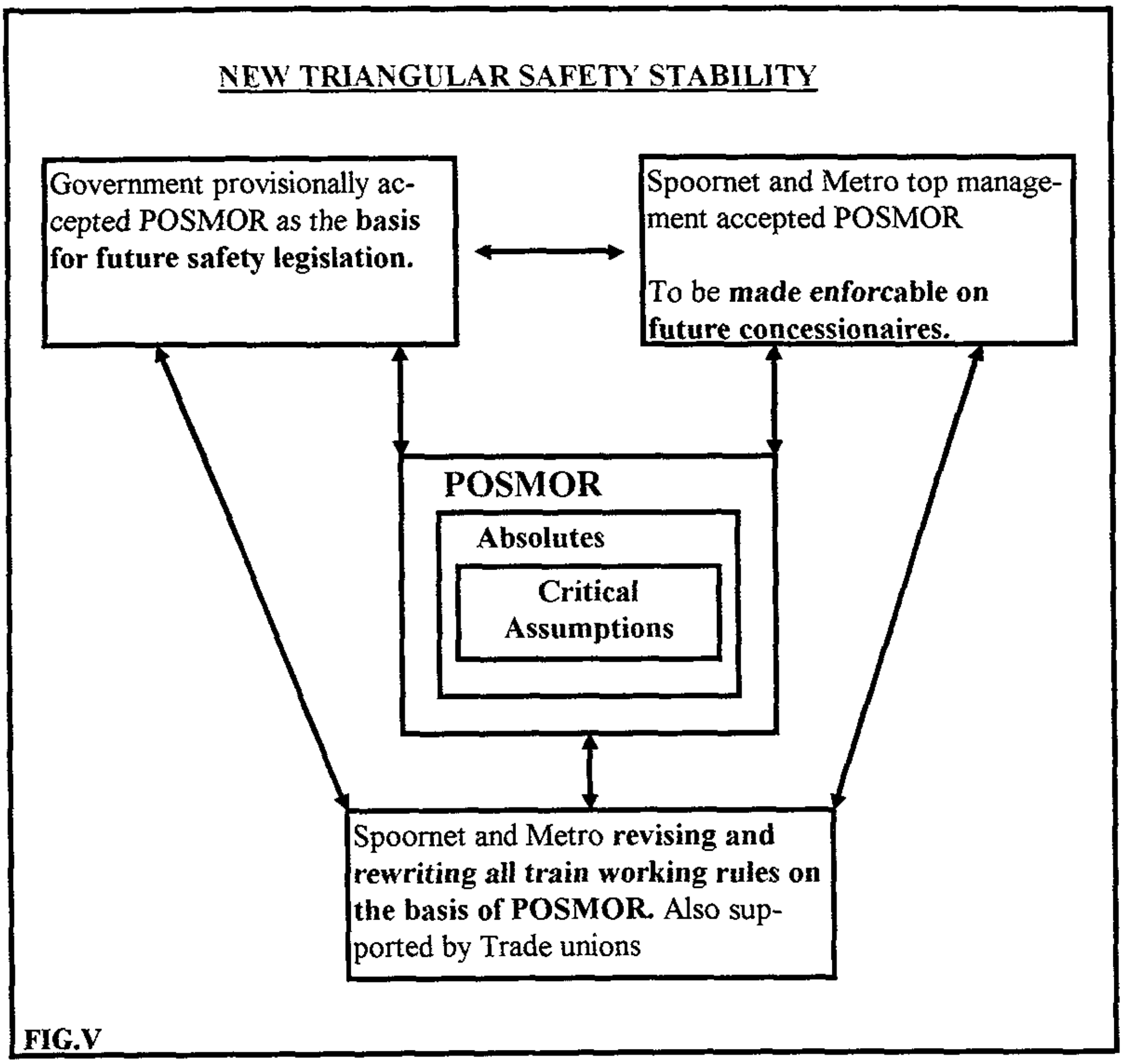


FIG.V

4. POSMOR PUT TO THE TEST :-

The principles of safe movement on rail have been and will in future be tested by the application of different and divergent scenarios.

4.1 => Top Management of Spoornet and Metro (the commuter train service) have accepted the principles and directed application.

=> It is realised that neither railway presently fully complies to all the principles. Capital would be required to re-engineer some of the technology used and certain existing train control systems will have to be eliminated or receive intensive overhaul.

=> This process will be initiated in the near future. POSMOR is becoming the driver of some capital expenditure.

4.2 => As previously pointed out the new government is revisiting existing acts and generates new legislation. Changes are frequent and sometimes dramatic.

=> A proposed governmental control body, called "The Rail Safety Regulator" posed the opportunity to use POSMOR as the departure point for controlling and policing any railway (including new concessionaires).

=> The Department of Transport accepted POSMOR. Spoornet and Metro are awaiting the publication of the principles in the second revision of the draft Land Transport bill which will encompass rail safety matters.

4.3 => POSMOR should, in future, be the common denominator of railway safety operations. Spoornet, Metro as well as any future concessionaires will have to demonstrate compliance.

=> It will be used as a prerequisite in tender documentation in that the concessionaires must describe how the technology, training investments, etc. he intends using, will comply to every principle.

=> Adjudication of tenders will also be adjudicated on even level by using POSMOR as the yardstick.

=> To a certain extent this is a new approach to the "Safety Case" concept. It is expected that every role player will clearly state how he intends "living" the POSMOR safety principle.

4.4 => Efforts are being made to unite the Southern African railways into a borderless train operating system. At the moment seven railways from seven countries are participating in this process.

=> All representatives from the seven railways at the Southern African Development Community meetings have accepted POSMOR as the departure point to regulate a borderless train working system.

=> The process ahead will be to test each railway's train working rules against the principles. Amending rules is a possibility and in certain cases it may even be necessary for African State Governments to adapt existing railway legislation or even formulate new bills in order to comply with POSMOR.

4.5 => An auditing system called "Rulebook on a page" is being developed. "Rulebook on a page " is a three dimensional tabulation of principle versus responsible person versus the actual responsibilities within the train control system. The tabulated information can be refined to contain specifics of any particular train control system. (See Figure VII)

FIGURE VI

POSMOR TO THE TEST

* **Management accepts :**
Implication :
- Capital expenditure
- Train control system changes

* **Government provisionally accepts**
Implication :
- New rail safety legislation

* **Common denominator for all role-players**
Implication :
- Tender submissions
- Tender adjudications
- Safety case - different approach

* **Borderless African railways**
Implication :
- All seven participating railways accepts and checks rules
- Some states might have to change legislation

* **"Rulebook on a Page"**
- Auditing system.

FIG.VI

FIGURE VII

RULEBOOK ON A PAGE

		Involved Employee		
	Responsibility	**Train driver**	**Train control officer**	**Etc.**
PRINCIPLE	**"Line clear" principle**	***Obtain and confirm correct authority before initiating or continuing motion.** ***Be alert and vigilant**	***Obtain confirmation from preceding train.** ***Obtain confirmation from neighbouring train control officers** ***Issue and confirm correct authority**	

FIG.VII

5. CONCLUSION

Spoornet is not bordered by First World railways In a situation as set out in this paper it is difficult to measure the value and correctness of the outputs without a system to validate this product against other sources of expertise

In an effort to raise interest, articles were published in a number of international railway magazines. Very useful comments were received and some of the ideas were incorporated in the development of POSMOR

At present efforts are being made to aquire knowledge and expertise from international institutions such as, for example, the Institute for Signal Engineers to evaluate and validate the POSMOR processes

Spoornet must avoid a possible accusation that the rules of the railway safety-game were developed for own interest/benefit

It is imperative that the process is transparent and to receive criticism/support from established and renowned organisations

Should any of the representatives at this Safety Conference or their organizations be willing to provide expertise to assist in the validation process, Spoornet will be glad to hear from you and negotiate

Contact can be made during this conference or with Spoornet The author and presenter of this article is the contact person

No one should be accusing Spoornet of this :

FIGURE VIII

<u>**What we try to avoid**</u>

FIG.VIII

FIGURE IX

Therefore we request :	***Expertise to buy** into Spoornet *In order to • **Validate** what we do • Make our processes **transparent.**

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PRESENTER :- J de Villiers

FIGURE I

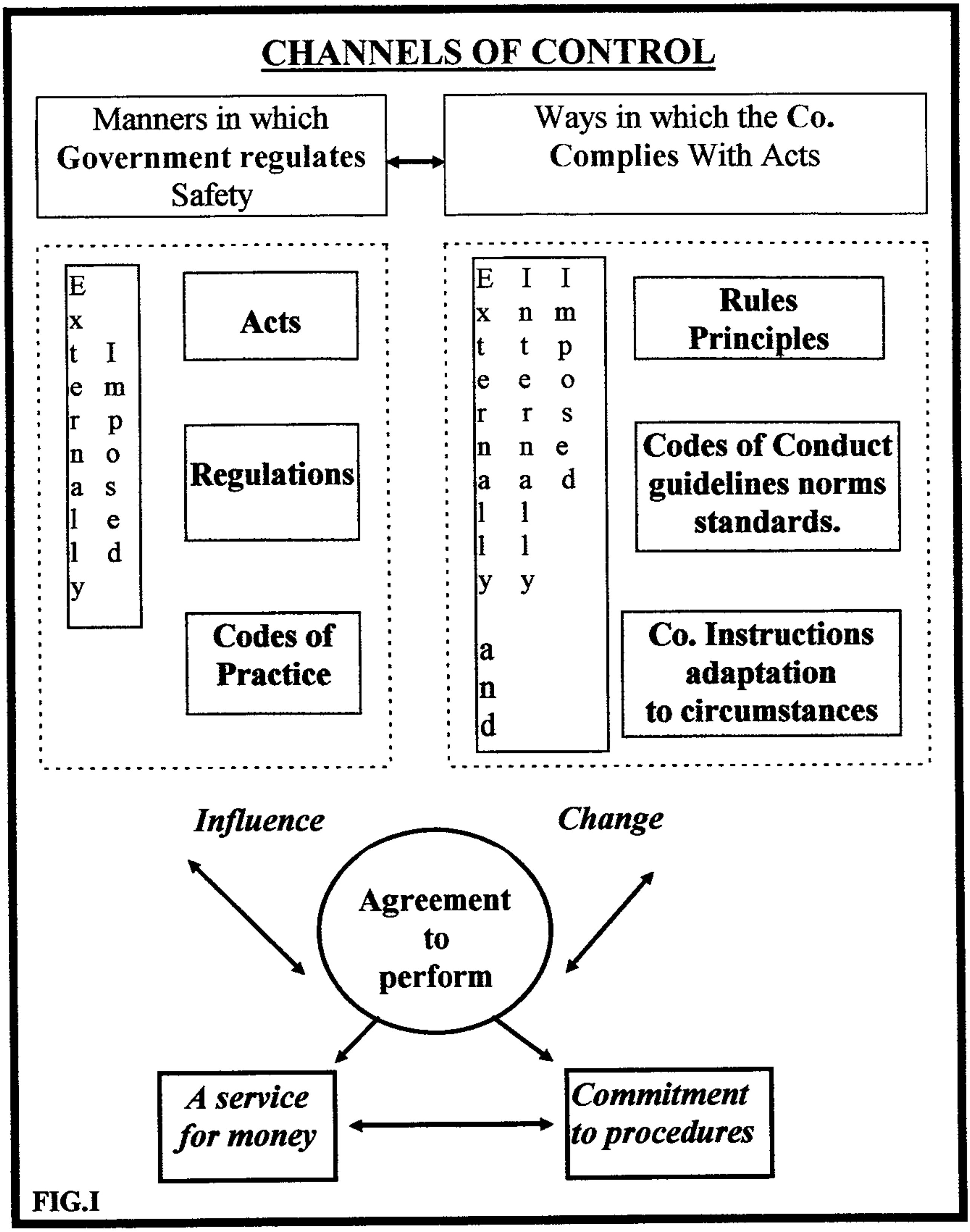

FIG.I

FIGURE II

THE RAILWAY SAFETY STABILITY TRIANGLE

Old regime in power for 48 years. New government **change/amend/-renew acts in rapid succession.**

Up to now only two roleplayers i.e. Metro and Spoornet. Now concessioning opens the way to foreign/new operators. **Competition from road and rail.**

Spoornet in process of **major reshaping for economical and political reasons.** Human element.

Note : **If all three corners of the safety triangle are unstable the possibility of a complete collapse becomes very real.**

FIG.II

FIGURE III

CRITICAL ASSUMPTIONS

* Be law abiding
* Accept social responsibility
* Safety must add practical value
* Withstand test of reasonable man
* Company rules compulsory and enforceable
* Safety has a price
* Employees will act in best interest of company

FIG.III

SPOORNET

FIGURE IV

THE FOUR ABSOLUTES

1. **Assurance** - the enforcement of multi-way compliance, by all role players, according to standards and procedures.

2. **Accountable** - all parties involved are to accept full accountability for their actions.

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4. **Adapt** - taking timeous and appropriate measures to suit abnormal or changing circumstances.

FIG.IV

SPOORNET

FIGURE V

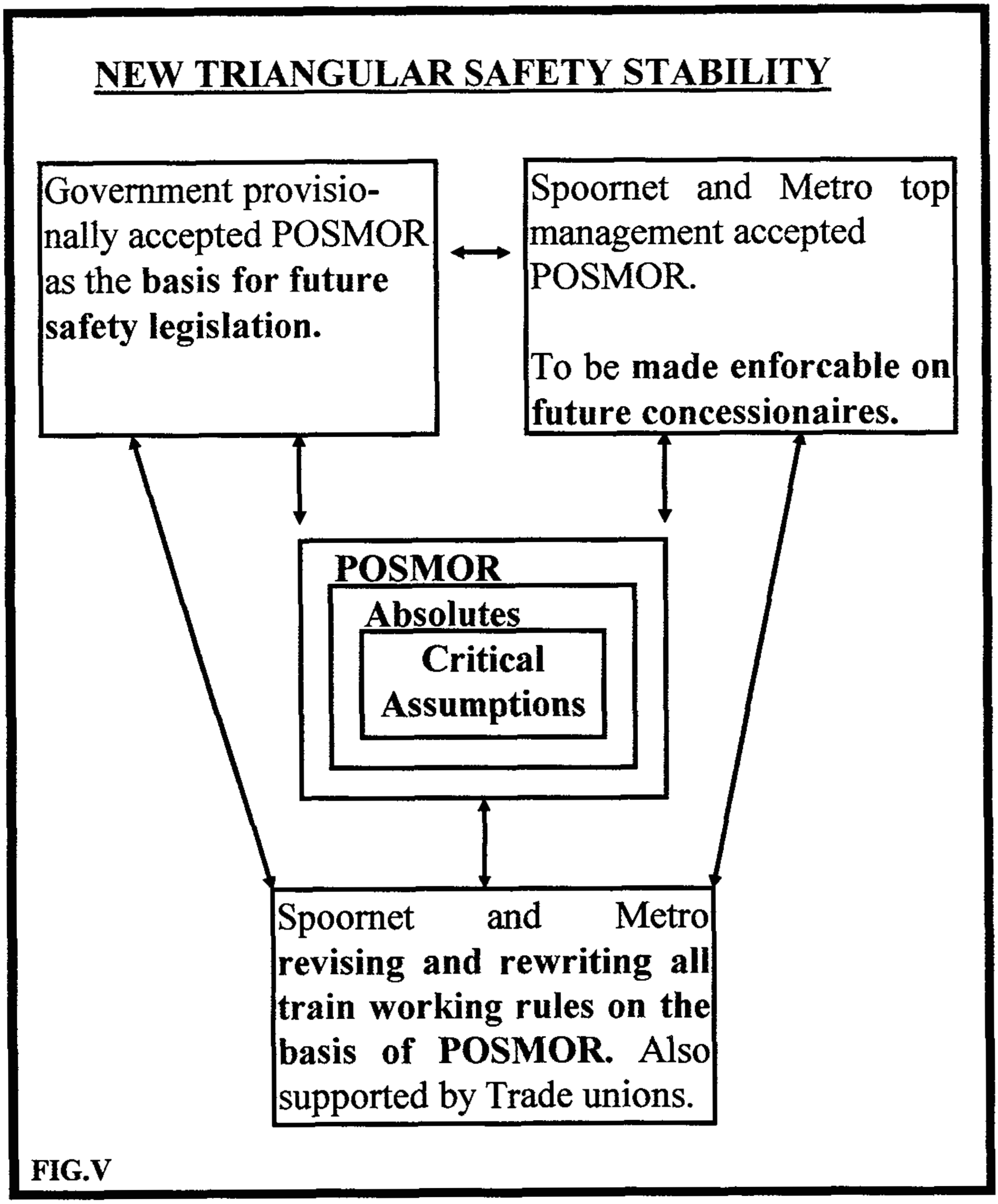
NEW TRIANGULAR SAFETY STABILITY
Government provisionally accepted POSMOR as the basis for future safety legislation.
Spoornet and Metro top management accepted POSMOR.
To be made enforcable on future concessionaires.
POSMOR
Absolutes
Critical Assumptions
Spoornet and Metro revising and rewriting all train working rules on the basis of POSMOR. Also supported by Trade unions.
FIG.V

FIGURE VI

POSMOR TO THE TEST

* **Management accepts :**

Implication :
- Capital expenditure
- Train control system changes

* **Government provisionally accepts**

Implication :
- New rail safety legislation

* **Common denominator for all role-players**

Implication :
- Tender submissions
- Tender adjudications
- Safety case - different approach

* **Borderless African railways**

Implication :
- All seven participating railways accepts and checks rules
- Some states might have to change legislation

* **"Rulebook on a Page"**
- Auditing system.

FIG.VI

SPOORNET

FIGURE VII

RULEBOOK ON A PAGE

		Involved Employee		
	Responsibility	Train driver	Train control officer	Etc.
PRINCIPLE	"Line clear" principle	*Obtain and confirm correct authority before initiating or continuing motion. *Be alert and vigilant.	*Obtain confirmation from preceding train. *Obtain confirmation from neighbouring train control officers. *Issue and confirm correct authority.	

FIG.VII

SPOORNET

FIGURE VIII

What we try to avoid

PEANUTS **By Charles Schulz**

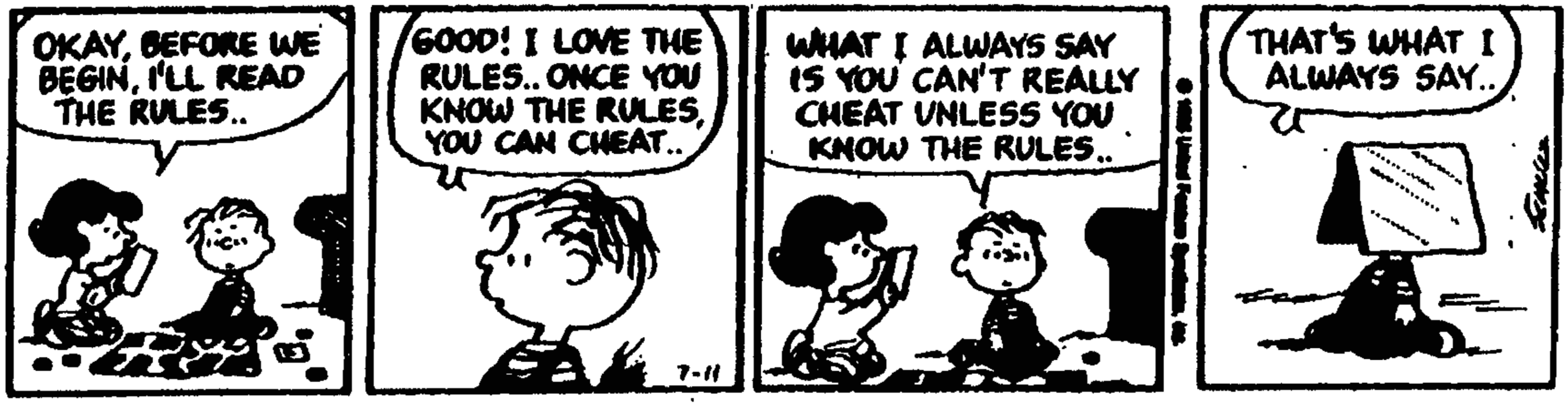

FIG.VIII

SPOORNET

FIGURE IX

<u>**Therefore we request**</u> **:**

***Expertise to buy** into Spoornet.

*In order to :

- **Validate** what we do.
- Make our processes **transparent.**

FIG.IX

SPOORNET		Document Ref. No. DRAFT
Subject:	CODE OF CONDUCT FOR SAFE MOVEMENT ON RAIL	Document Revision No.
Controlling Officer:	Assistant Manager (Operating Directives), Spoornet Head Office	Page 1 of 15
Approving Officer:	Assistant General Manager (Operating), Spoornet Head Office Signature:	Effective Date:

1 PURPOSE

This document lays down the principles on which all procedures and instructions for safe movement on rail shall be based

2 SCOPE

This document is applicable to Spoornet employees who

- formulate or approve policies, procedures and instructions pertaining to the operation of trains,
- drive locomotives and motor trolleys;
- control the movement of rolling stock,
- ensure the technical serviceworthiness of rolling stock and infrastructure

It also serves as a guide for the safe movement of rolling stock

- in other divisions of Transnet;
- for other owners of infrastructure where Spoornet trains operate,
- for other owners of rolling stock operating on Transnet controlled infrastructure

3 FOREWORD

Spoornet continuously strives to be

> A law-abiding, commercial organisation following safety principles which
>
> are reasonable and practicable,
>
> are believed and followed by all employees for the safety of themselves, their colleagues, customers and society,
>
> protection freight, assets and the environment,
>
> with minimum restrictive practices, and
>
> promotes an ethic of responsible behaviour toward the well-being of the organisation and its stakeholders

4 INTRODUCTION

The movement of rolling stock on Spoornet railway lines is governed by this code of conduct, as well as in work procedures and instructions, that are based on the safe, reasonable and affordable principles outlined herein

A code of conduct prescribes an employee's actions in the performance of his duties in a way that such duties will be carried out in a safe and efficient manner

This Code of Conduct shall serve as a basis for -
- technological design and development relating to safe movement on rail
- the formulation of specific rules, codes of work procedures and instructions
- contracts and agreements with other parties relating to movement on rail
- the formulation of training modules and manuals
- considering disciplinary procedures
- considering legal action

5 DEFINITIONS

In this Code of Conduct and in other relevant train working rules, work procedures and instructions, unless inconsistent with the context,

"5.1 **authorise:** means the granting of permission, in any form, by a licensed person, allowing another person to undertake a task",

"5.2 **authority:** means the written, oral or other means of allowing a licensed person to undertake a specific task, within a defined area",

"5.3 **clear:** means that the track/line is free of detectable obstructions within the structure gauge",

"5.4 **conflicting movement:** means a movement that can result in a head-on, side-on or rear-on collision with a train, shunt or rolling stock, either moving or stationary",

"5.5 **continual communication:** means the oral and/or visible communication that must take place, whenever and wherever required and in the prescribed manner",

"5.6 **defined track:** means the fixed limits or boundaries of the portion of line required for a movement, which can include the route",

"5.7 **driver:** means the licensed employee/person in control of a self-propelled rail vehicle",

"5.8 **fall-back procedure:** means the predetermined, laid down procedures/measures to be implemented to ensure continued safe working when the normal working procedure is interrupted",

"5.9 **handshaking:** in relation to an authority means the process of ensuring that communication, by any means, has been understood by the one receiving it, so that the authority will be carried out as intended",

"5.10 **infrastructure:** means the fixed signal, overhead electric, permanent-way and communication installations and associated structures/fixtures necessary to operate a railway",

"5.11 **licensed:** means the formal authorisation by the railway operator of a competent employee/person to perform certain duties",

"5.12 **line; track:** means a railway line",

"5.13 **locomotive:** means a self-propelled rail vehicle, or set of rail vehicles, designed to haul trains or for shunting purposes",

"5.14 **movement:** means a train or shunting movement", "5.15 **protect:** means any measures designed and/or taken to prevent conflicting movements and/or unsafe conditions",

"5.16 **rolling stock:** means vehicles capable of running on a railway line, including any self-propelled and non-self-propelled vehicles",

"5.17 **serviceworthy:** means that the rolling stock, loaded or empty, either singularly or in combination, is fit to operate safely on a railway line, with or without prescribed conditions",

"5.18 **shunt:** means a locomotive with or without vehicles attached, engaged in shunting",

"5.19 **shunting:** means the movement of rolling stock, to, from or on a running line or siding, within the shunting limits",

"5.20 **train:** means a self-propelled rail vehicle, or vehicles in specific composition coupled to their locomotive, having a marker, specific identification and destination, standing on or passing over a definite route",

"5.21 **trainworthy:** means that the infrastructure is sound to accept rolling stock, with or without prescribed conditions/restrictions",

6 THE PRINCIPLES FOR SAFE MOVEMENT ON RAIL

The following principles are all of equal importance and are expounded in more detail hereafter:

6.1 Common to Personal Behaviour

6.1.1 be fit for duty
6.1.2 be alert, vigilant and assess surroundings
6.1.3 responsibility cannot be shared

6.2 Common to Movement

6.2.1 rolling stock must be serviceworthy
6.2.2 infrastructure must be trainworthy
6.2.3 authority to be issued, accepted and "handshaken"
6.2.4 know location, extent and limitation
6.2.5 consider feasibility of execution
6.2.6 have continual communication

6.3 Authority

6.3.1 shall be issued and accepted only by licensed persons
6.3.2 shall have one meaning only
6.3.3 shall not allow conflicting (following or opposing) movements
6.3.4 holds good until executed or surrendered/ withdrawn.

6.4 Before moving

6.4.1 the track must be defined
6.4.2 the defined track must be clear
6.4.3 issue/obtain authority

6.5 Whilst moving

6.5.1 adhere to speed instructions
6.5.2 adhere to trackside and other indicators

6.6 Stop

6.6.1 at limit of movement
6.6.2 when and where scheduled

6.7 Whilst stationary

6.7.1 stand clear (not foul)
6.7.2 be secured (against movement)
6.7.3 be protected

6.8 Common to abnormal conditions

6.8.1 have a hierarchy of fall-back procedures

7 COMMON TO PERSONAL BEHAVIOUR

These principles address the behaviour of all persons in the train operation environment

7.1 Be fit for duty

means that a person must

7.1.1 be well-rested before assuming duty

7.1.2 be generally and physically fit, and mentally able to do duty

7.1.3 be emotionally stable

7.1.4 before assuming duty and whilst on duty, never partake of intoxicating liquor and/or narcotic drugs, or any medication, which affects or is likely to affect the proper performance of his duties

7.2 Be alert, vigilant and assess surroundings

means that a person must

7.2.1 devote his full attention to his job

7.2.2 constantly evaluate his working environment in order to obtain additional information which will dictate or influence his line of action to ensure safe and efficient working

7.2.3 be consciously observant in the workplace and its environs

7.3 Responsibility cannot be shared

means that a person must

7.3.1 always be responsible for his own health and safety, and the well-being of his family, his employer, his colleagues, the public and the environment

7.3.2 establish his area of responsibility and accountability

7.3.3 always act in the best interests of the Company

7.3.4 always obey Company rules/codes of work procedures/instructions

7.3.5 never exceed the scope of his license, except in an emergency, and then take full responsibility for his actions

7.3.6 remember that responsibility can never be transferred to or shared with anybody else

8 COMMON TO MOVEMENT

These principles relate to the elements which must apply before and during any movement on rail

8.1 Rolling stock must be serviceworthy

means that

8.1.1 rolling stock must be technically sound, with or without prescribed conditions or restrictions

8.1.2 any conditions or restrictions imposed on one vehicle in a consist, for whatever reason, applies to the whole consist

8.1.3 vehicle loads must conform to loading specifications

8.2 Infrastructure must be trainworthy

means that

8.2.1 the infrastructure must be technically sound, with or without prescribed conditions/restrictions, and in a condition to ensure safe and efficient train or shunting movements

8.3 Authority to be issued, accepted and "handshaken"

must be interpreted to mean that

8.3.1 no movement may take place without the correct authority

8.3.2 an authority must be issued before a movement may take place

8.3.3 before moving the driver must obtain an authority

8.3.4 where prescribed, the authority must be handshaken by the persons concerned

8.3.5 obtaining an authority and handshaking it, where prescribed, is acceptance of responsibility for its execution

8.4 Know location, extent and limitation

means that

8.4.1 before an authority is issued for a train or shunting movement, the person issuing it must establish the exact position of the train or shunt by the technical or other means at his disposal

8.4.2 the persons issuing and accepting an authority must have a clear understanding of and be in agreement with the full extent of the intended movements

8.4.3 the persons issuing and receiving an authority must, when planning a movement, acquaint themselves with prevailing limitations, for instance

- insufficient time to carry out a movement
- adverse weather conditions
- yard/traffic congestion
- insufficient line/yard capacity
- poor visibility
- insufficient manpower
- insufficient braking power in relation to train/shunt mass
- restrictions on train/shunt length and composition

8.5 Consider feasibility of execution

means that

8.5.1 a movement may only be undertaken if all persons concerned have, within the ambit of their duties, confirmed, up to the time of commencement of the movement, that it is possible to do it safely and efficiently

8.5.2 before an authority is issued, the employee issuing it must ensure that the person receiving it will be able to fully execute it

8.5.3 before an authority is acted upon, the licensed person concerned must ensure that it is possible to execute the movement

8.6 Have continual communication

means that

8.6.1 wherever possible there must be regular communication, in whatever form provided, between all persons concerned with train and shunting movements, and with persons working on or near the line, in order to ensure train and shunting movements will be carried out safely and efficiently, e.g

8.6.1.1 oral - where any form of oral communication is provided to facilitate train or shunting movements, there must be close collaboration and regular communication, in the prescribed manner, between the employees/persons concerned, especially while movements take place

8.6.1.2 visible - where visible signals are used, they must be regularly or continually (depending on the type of signals and the circumstances) displayed so as to leave no doubt in the minds of the employees/persons concerned as to what is expected of them

8.7 AUTHORITY

These principles deal with the different aspects relating to **authority** in train and shunting movements and in this context **authority** comprises **three** elements, viz Human, dynamic and physical

The **human** element is represented by the licensed person issuing/giving the authority and the licensed person receiving and executing it

The **dynamic** element is the activity or physical movement associated with trains and shunts within a defined area

The **physical** element is the defined area within which the authority, issued in respect of trains and shunts, is valid

8.7.1 Shall be issued and accepted only by licensed persons

means that an authority to permit a train or shunting movement must be

8.7.1.1 issued/given in the prescribed format

8.7.1.2 issued by licensed employees only

8.7.1.3 received and accepted by licensed persons only

8.7.2 Shall have one meaning only

means that an authority must

8.7.2.1 be clear and to the point

8.7.2.2 have only one intended outcome

8.7.2.3 have the same interpretation by all persons involved

8.7.2.4 be in accordance with the prescribed format and interpretation

8.7.3 Shall not allow conflicting (following or opposing) movements

means that

8.7.3.1 every train or shunting movement must be so planned, authorised and carried out as to avoid or prevent any conflicting movement involving

8.7.3.1.1 a stationary or moving train or shunt

8.7.3.1.2 stationary or moving rolling stock

> **NOTE** - *A conflicting movement must not be confused with an irregular movement, because the latter will not necessarily lead to conflicts in movements*

8.7.4 Holds good until executed or surrendered/withdrawn

means that an authority is valid

8.7.4.1 for the full length of the train or shunt within the defined area
until the train or shunting movement is complete, i e has exited the limits of the defined area

8.7.4.2 it is withdrawn by or is surrendered to a licensed person before the movement is completed

8.8 BEFORE MOVING

These principles deal with the steps to be taken before a movement is authorised

8.8.1 The track must be defined

means that

8.8.1.1 the person/s concerned must, by the means at his/their disposal, predetermine the line on/over which the movement is to take place. i e the defined line must have a given departure point and a given destination point In addition, all the points that have to be set for the movement, must be identified

8.8.1.2 When two or more persons are concerned in defining the line. they must all be in agreement

8.8.2 The defined track must be clear

means that

8.8.2.1 the person who is to authorise a movement, must, before authorising it, ensure through the technical or other means at his disposal and to the best of his knowledge, that the defined line between the given departure point and the given destination point is free of detectable obstructions and that,

8.8.2.2 where applicable, the points are correctly set

8.8.2.3 the recipient must, after receiving the authority to move, ensure, as far as he can see and or establish, that the line is clear within the structure gauge, and this he must also do while the train/shunt is in motion

8.8.3 Issue/obtain authority

means that when a movement is to take place

8.8.3.1 it may only take place once an authority has been issued

8.8.3.2 the authority must include the beginning and the end of the movement

8.8.3.3 only one authority at a time may be issued for a movement

8.8.3.4 the movement must be completed before a new authority is issued

8.8.3.5 an authority may combine a number of movements

8.9 WHILST MOVING

These principles deal with responsibilities of a driver to ensure that his train or shunting movement is being carried out safely

8.9.1 Adhere to speed instructions

means that the driver must regulate the speed of the movement

8.9.1.1 by strictly complying with the relevant speed instructions

8.9.1.2 by obeying all applicable speed limiting boards, and any speed-related track signs, indicators and hand signals

8.9.1.3 when circumstances demand a speed reduction

8.9.2 Adhere to track-side and other indicators

means that the driver must

8.9.2.1 in the interest of safety and efficiency, strictly observe and obey any non-speed-related trackside and other indicators provided alongside or above the track

8.10 STOP

These principles deal with the responsibilities of a licensed person, relating to when and where a movement must be stopped

8.10.1 at limit of movement

means that the licensed person in charge of a train or shunting movement must

8.10.1.1 proceed to the destination point (limit) prescribed by his authority

8.10.1.2 stop at the limit of his authority unless, before stopping, he receives a further authority to proceed to the next destination point (limit)

8.10.1.3 when and where required to stop by force of circumstances

8.10.2 when and where scheduled

means that the driver must stop his train only

8.10.2.1 when and where scheduled in a time-table or notice

8.10.2.2 when and where specially arranged, preferably in writing

8.11 WHILST STATIONARY

These principles deal with the safeguarding of rolling stock

8.11.1 stand clear (not foul)

means that

8.11.1.1 where there are converging lines, a train, shunt or rolling stock must be left standing inside the clearance mark so as to ensure its safety, as well as the safety of approaching and/or passing movements on the adjoining line

8.11.2 be secured (against movement)

means that

8.11.2.1 a train, shunt or rolling stock, left standing on a line, must be secured in the prescribed or an appropriate manner against movement in order to ensure its own safety, as well as the safety of approaching and/or passing movements on the adjoining line

8.11.3 be protected

means that

8.11.3.1 measures have to be taken to prevent conflicting or irregular movements and unsafe conditions involving stationary and moving trains, shunts or rolling stock

8.12 COMMON TO ABNORMAL CONDITIONS

This principle deals with the breakdown in normal working procedures

8.12.1 have a hierarchy of fall-back procedures

means that

8.12.1.1 in the event of normal working being interrupted there are predetermined/laid down procedures or measures, which must be common knowledge to all persons concerned with train and shunting work, or work on or near the line, to ensure safety and uniformity until normal working is resumed

--O--

SPOORNET

TRAINING MANUAL

BASED ON THE

PRINCIPLES FOR SAFE MOVEMENT ON RAIL

INDEX

OBJECTIVES

After having made a thorough study of the training manual, you should be able to

1 Know the definitions for safe movement on rail

2 Give a brief description of the three factors common to personal behaviour

3 Understand the six factors common to movement

4 Define authority

5 Explain the different factors

- 5 1 Before moving
- 5.2 Whilst moving
- 5 3 Stop
- 5 4 Whilst stationary

6 Describe what is meant by fall-back procedures

TRAINING MANUAL

BASED ON THE

PRINCIPLES FOR SAFE MOVEMENT ON RAIL

1. PURPOSE

This Training Manual is based on the Principles for Safe Movement on Rail and is meant to shed more light, and to elaborate somewhat on these principles in order to

- gain common insight and understanding into them and their application,
- instil a culture of responsibility and accountability through a disciplined safety approach, and
- ensure that their application will result in a positive modification of behaviour

2. SCOPE

The principles are applicable to all Spoornet employees who are tasked and/or licensed to

2 1 formulate or approve policies, procedures and instructions pertaining to the operation of trains,

2 2 drive locomotives and motor trolleys

2 3 control the movement of rolling stock,

2 4 ensure the technical serviceworthiness of rolling stock and infrastructure,

It also serves as a guide for the safe movement of rolling stock

2 5 in other divisions of Transnet,

2 6 for other owners of infrastructure where Spoornet trains operate;

2 7 for other owners of rolling stock operating on Transnet-controlled infrastructure

3. FOREWORD

Spoornet continuously strives to be

> A law-abiding commercial organisation following safety principles which
>
> are reasonable and practicable,
>
> are believed and followed by all employees for the safety of themselves, their colleagues, customers and society,
>
> protect freight, assets and the environment,
>
> have minimum restrictive practices, and
>
> promote an ethic of responsible behaviour toward the well-being of the organisation and its stakeholders

4. INTRODUCTION

Train working regulations/rules can be traced back to the running of the very first train/s on a railway line At that early stage it became quite clear that some or other form of control to regulate the movement of trains in order to ensure safe operations, was inevitable Even with today's modern technology it is quite unthinkable that train and shunting movements should be allowed to take place without any form of "regulation" or control, and that is exactly what "regulation" means - to <u>regulate</u> or <u>control</u> Therefore, the compliance with the regulations/rules/instructions must not only ensure order in train and shunting movements, but it must also ensure the maximum degree of safety Dangerous conditions (near misses), accidents - even fatal accidents - would have been the order of the day if there were no rules to go by Regulations or rules are therefore vitally necessary and must be strictly obeyed to ensure safe and efficient working However, if they are not absolutely unambiguous - i e absolutely clear so as to be able to be understood, believed and applied by all in the same way - they could be branded as ineffective

The Train Working Regulations/Rules have, over the past 50 years, been rewritten and reprinted on two occasions, the last time some 30 years ago However, the fact that they also have had to be amended on many occasions, indicates that they have never been, and aren't at this stage, perfect

Apart from this imperfection, a further element must receive serious consideration, namely the requirements of Act No 85 of 1993 (Occupational Health and Safety Act, 1993) because, whereas the present Train Working Rules have mainly been designed to prevent accidents to railway assets and to persons, Act No 85 of 1993 also specifically stresses the protection of the environment All train working rules must therefore be tested against the requirements of Act No 85 of 1993 and rewritten, if necessary Although the present rules are not wrong, some of them are not "connected" Act No 85 of 1993 requires that a safety management system be established and, therefore, where necessary, certain rules will have to be changed to comply with the requirements of Act No 85 of 1993, and they must, furthermore, be able to stand the test of the reasonable man

To start off with, a list of principles relating to safe movement on rail have been drawn up, and it is those principles that will be dealt with in this Manual

A further reason why it is necessary to rewrite the train working rules is the fact that rules often contain so many cross-references that it is difficult to "piece together" all the relevant instructions to obtain an overall picture and an all-embracing instruction

Losses, especially those caused through train accidents, are a constant cause for concern and it could very well be that some of them could be ascribed to the fact that there has not been a set of plain, understandable principles that would have enabled the staff concerned to understand exactly what was required of them under the circumstances prevailing at the time This was the driving force behind the formulation of the principles expounded in paragraph 3 hereof

5. DEFINITIONS APPEARING IN THIS MANUAL

assisting locomotive : an additional locomotive, or set of locomotives, coupled to a train to assist such train or used to afford assistance or to clear an obstruction,

authorise : the granting of permission, in any form, by a licensed person, allowing another person to undertake a task,

authority : the written, oral or other means of allowing a licensed person to undertake a specific task, within a defined area,

bogie : the assembly which supports and allows the steering of a vehicle, and which houses the wheel pairs, brake equipment, suspension and, in the case of locomotives, the traction motors,

clear : the track/line is free of detectable obstructions within the structure gauge,

clearance mark : a horizontal white line between two converging lines, which indicates the minimum distance at which rolling stock may stand from the points/crossings,

conflicting movement : a movement that can result in a head-on, side-on or rear-on collision with a train, shunt or rolling stock, either moving or stationary,

continual communication : the oral and/or visible communication that must take place, whenever and wherever required, and in the prescribed manner,

crossing place : an unattended place on a single line in centralised traffic control, radio train order and radio train token territory where trains may cross or pass each other,

defined track : the fixed limits or boundaries of the portion of line required for a movement, which can include the route,

driver : the licensed employee/person in control of a self-propelled rail vehicle,

fall-back procedure : the predetermined, laid down procedures/measures to be implemented to ensure continued safe working when the normal working procedure is interrupted,

halt : an unattended place on a running line where certain trains are required or scheduled to stop,

handshaking, in relation to an authority : the process of ensuring that communication, by any means, has been understood by the one receiving it, so that the authority will be carried out as intended,

infrastructure : the fixed signal, overhead electric, permanent-way and communication installations and associated structures/fixtures necessary to operate a railway,

interloop : an unattended place where trains can cross or pass each other and where no train control instruments are in operation,

licensed : the formal authorisation by the railway operator of a competent employee/person to perform certain duties,

light locomotive : a locomotive or a set of locomotives running as a train, without a load,

line/track : a railway line,

locomotive : a self-propelled rail vehicle, or set of self-propelled rail vehicles, designed to haul trains or for shunting purposes,

panel : any appliance equipped for direct or indirect operation, and used in train-control centres/stations to reflect train positions and the location and condition of signals, points, track circuits and routes,

protect : any measures designed and/or taken to prevent conflicting movements and/or unsafe conditions,

railway operations controller : a person who operates and/or controls a railway system or any section, area or region thereof.

rolling stock : vehicles capable of running on a railway line, including any self-propelled and non-self-propelled vehicles,

running line : a line normally set apart for the passage of trains,

section : that portion of the running line between -

(a) two adjacent train control stations,
(b) two adjacent token stations,
(c) two adjacent interloops,
(d) a train control station and an adjacent station,
(e) a train control station and an adjacent interloop,
(f) a token station and an adjacent interloop,
(g) a train control station and an adjacent crossing place,
(h) two adjacent crossing places,
(i) a train control station/centre and an adjacent interlocking area, or
(j) two adjacent interlocking areas,

serviceworthy : means that the rolling stock, loaded or empty, either singularly or in combination, is fit to operate safely on a railway line, with or without prescribed conditions.

shunt : a locomotive with or without vehicles, engaged in shunting,

shunter : the employee, irrespective of grade, involved in coupling and uncoupling of rolling stock and the control of movements within the shunting limits,

shunting : the movement of rolling stock to, from, or on a running line or siding, within the shunting limits decided upon for such movement,

siding : any line other than a running line,

special train : an additional train, not provided for in the normal train service,

station : a place on a running line where certain trains are scheduled to stop, with an authorised/licensed person on duty, whether trains can cross or pass there or not.

token : a tangible authority which is handed to, or is completed/obtained by a driver to proceed over a prescribed section of a single line under specified conditions,

track/line : a railway line,

traffic controller : the licensed railway operations controller who is responsible for the working of trains and the operation of train control instruments and/or signals and points,

train : a self-propelled rail vehicle, or vehicles in specific composition, coupled to their locomotive, having a marker, specific identification and destination, standing on or passing over a definite route,

train movement : the working of a train on any railway line,

trainworthy : means that the infrastructure is fit to accept rolling stock under specified conditions,

vehicle: wagon : any passenger or goods vehicle or other form of conveyance intended or designed for transporting persons or goods on a railway line, or for any other purpose

6. PRINCIPLES FOR SAFE MOVEMENT ON RAIL

Before elaborating somewhat on the principles to be borne in mind by the staff concerned with the movement of trains and shunts, the following abbreviated list of the principles should, as far as they apply to the different members of the staff, be memorised and also read in conjunction with the definitions They are as follows

PRINCIPLES APPLICABLE TO TRAIN AND SHUNTING MOVEMENTS

	Responsibility for execution		
	Optg staff	Train staff	Other
6.1 Common to personal behaviour			
6 1 1 be fit for duty	√	√	√
6 1 2 be alert, vigilant and assess surroundings	√	√	√
6 1 3 responsibility cannot be shared	√	√	√
6.2 Common to movement			
6 2 1 rolling stock must be serviceworthy	√	√	√
6 2 2 infrastructure must be trainworthy		√	√
6 2 3 authority to be issued, accepted and "handshaken"	√	√	√
6 2 4 know location, extent and limitation	√	√	√
6 2 5 consider feasibility of execution	√	√	√
6 2 6 have continual communication	√	√	√

	Responsibility for execution		
	Optg staff	Train staff	Other
6.3 Authority			
6 3 1 shall be issued and accepted only by licensed persons	√	√	√
6 3 2 shall have one meaning only	√	√	√
6 3 3 shall not allow conflicting (following or opposing) movements	√	√	√
6 3 4 holds good until executed or surrendered/ withdrawn	√	√	√
6.4 Before moving			
6 4 1 the track must be defined	√	√	√
6 4 2 the defined track must be clear	√	√	√
6 4 3 issue/obtain authority	√	√	√
6.5 Whilst moving			
6 5 1 adhere to speed instructions		√	√
6 5 2 adhere to trackside and other indicators		√	√
6.6 Stop			
6 6 1 at limit of movement	√	√	√
6 6 2 when and where scheduled		√	√
6.7 Whilst stationary			
6 7 1 stand clear (not foul)	√	√	√
6 7 2 be secured (against movement)	√	√	√
6 7 3 be protected	√	√	√
6.8 Common to abnormal conditions			
6 8 1 have a hierarchy of fall-back procedures	√	√	√

Now let us have a closer look at each of the "principles", using the same numbering

6.1 COMMON TO PERSONAL BEHAVIOUR

6.1.1 Be fit for duty

Any employee who is concerned with the running of trains and/or with shunting operations, and especially a member of the train staff, must ensure, before reporting for duty, that he is absolutely fit to take up duty He must see to it that he is well-rested, generally fit and emotionally stable so as to perform his duties safely and efficiently throughout his shift He is not allowed to consume alcohol or drugs in any form, or even over-the-counter medication, that is likely to have a negative effect on the proper performance of his duties

An employee who supervises the signing for duty functions of train and/or operating staff, or who has to hand over duty to one of them, must ensure, without a doubt, that the employee who is to take over is fit and capable to safely carry out the duties assigned to him

6.1.2 Be alert, vigilant and assess surroundings

When considering this principle one is inclined to think mainly of train staff having to be "wide awake" while their train or shunt is moving While this is so, it also applies at all times to all employees who in some or other way have something to do with train or shunting movements Transnet has to pay millions of rand every year for claims and damage resulting from train accidents, and the need to be observant and vigilant cannot be too strongly emphasised As a very famous American Safety Manager so aptly put it "Be where you are with all your mind!" This means that the employees must devote their full attention to their job!

The traffic controllers, yard staff, train staff and others who authorise or are about to authorise, or who carry out or are about to carry out, train or shunting movements, must carefully survey and evaluate the area (working environment) in which the movement is to take place or is taking place, to ensure that no harm will be done to the train/shunt, road vehicles, persons and/or the environment

For instance, before starting to shunt or while shunting in sidings, all concerned must ensure that no road vehicles (including road, rail or overhead cranes) are obstructing or will obstruct the line while the movement/s is/are being carried out Likewise, persons loitering nearby or those busy loading/unloading/inspecting vehicles must be warned to stand clear And what about a train approaching populated areas - or a level crossing - where a driver should take special note of the "surroundings", i.e the conditions "surrounding" his train? A number of other examples could have been given

Suffice it to say that the shunting staff responsible for making up a train load, as well as the train staff working the train, must be constantly conscious of the dangers and dangerous conditions that can arise should accidents occur when hazardous commodities are shunted or conveyed, but they must also be conscious of such commodities stored or manufactured on premises adjoining the railway tracks Failure to pay special attention to possible hazards or to hazardous commodities can lead to very serious conditions or accidents which could have tragic consequences

6.1.3 Responsibility cannot be shared

This can best be illustrated in the case of two employees doing the same job - for instance a driver and his assistant, a traffic controller and his assistant, etc It must always be remembered that in such cases it is the employee assigned with the task - and only he - who is responsible for the safe and efficient execution of the task assigned to him A driver dare not rely only on his assistant to observe signals and to ensure that the authority to move is the correct one It is his - the driver's - responsibility and only his In the same way a traffic controller or a yard employee who has to admit a train to a station or yard, must himself ensure that the line to which the train is to be admitted, is clear for its safe admittance He dare not leave that responsibility to someone else

To sum up -

An employee must

- always be responsible for his own health and safety, and the well-being of his family, his employer, his colleagues, the public and the environment
- establish his area of responsibility and accountability
- always act in the best interests of the Company
- always obey Company codes of work procedures/rules/instructions
- never exceed the scope of his license, except in an emergency, and then take full responsibility for his actions
- remember that responsibility can never be transferred to or shared with anybody else

6.2 COMMON TO MOVEMENT

6.2.1 Rolling stock must be serviceworthy

"Serviceworthy" means a number of things For instance, a train load cannot just be made up, the locomotive attached and the train allowed to depart There are numerous things, all relating to the safe running and the safe handling of the train en route, that have to receive special attention We take a closer look at the components of "serviceworthiness"

Serviceworthiness includes the examination and certification of the rolling stock

When a road vehicle, for instance, is taken to the testing grounds to be tested for roadworthiness, it is subjected to a number of strenuous tests before it is declared "roadworthy" Very often the owner must have certain adjustments - even repairs - carried out before the examiner is satisfied A train (including the locomotive) must also pass a strenuous test before it is certified (passed) as serviceworthy

To start off with, the train must have an effective brake if it is to travel safely - especially if it has to negotiate down gradients The responsible official must ensure that the brake connections between all the vehicles - extending from the locomotive up to the last vehicle on the train - are securely coupled He must also ensure that all the hand brakes are released But all this will be of no use if the brake blocks throughout the train are defective or badly worn - or even incorrectly adjusted The whole system must, therefore, receive special attention

Apart from the brake system it must also be ensured that all the couplers between all vehicles have been/are securely coupled, all doors closed and secured, and all chains, tarpaulin ropes, etc properly tied Careful attention must also be given to the loads inside the vehicles - e g the loads must, where this can be established, be evenly spread and secured in such a way that they will not shift

Lastly, the brake "reading" must be taken - in the locomotive and at the rearmost vehicle - and it must be ensured that the minimum laid down brake power is available to ensure that the train will be safely controlled down the steepest gradients en route

In so far as the mechanical/technical serviceworthiness of the train is concerned, the responsible technical employee must issue a "certificate" to that effect before the train is allowed to depart

Apart from the foregoing, the <u>train composition must be known</u>

Now what does this mean - what is "train composition", who must know it, and why is it important? To start off with, the <u>train composition</u> simply tells us which vehicles the train is <u>composed of</u> and in what order they are marshalled = (composition) Because the driver of the train is responsible for the safe running/handling of the train, he must know exactly how long his train is (measured in the number of axles and by the length - length in metres) and what the total mass is (measured in tons) He must also know how the mass is spread over the length of the train, i e if the heaviest vehicle is marshalled immediately behind the locomotive and the lightest at the rear end of the train, and whether the weight (mass) of the vehicles decline from the front to the rear of the train This is very important for the safe handling/correct brake application by the driver

Before a train is allowed to depart from the starting station, the station yard staff, i e the employee responsible for the correct marshalling of the train, must hand to the driver a <u>certificate</u> - a Train Load Certificate - setting out all the particulars called for above, and the amount of brake power available on the train must also be specified

Should the train load change en route, i e should vehicles have to be attached to or detached from the load, the Train Load Certificate must be amended accordingly, as the driver must at all times have in his possession, in writing, every detail concerning his train load Without this information he will not be able to handle/control his train safely This information is also necessary in emergency situations All the rolling stock, therefore, must be technically sound, with or without prescribed conditions or restrictions

Lastly, the loading detail must be known

Just as it is of the utmost importance for the driver to know the exact details of the train composition so that he will be in a position to handle his train correctly to ensure train safety, so it is of the utmost importance to him to know the nature of the traffic his train is conveying, so that he can, when possible and when necessary, keep an eye on certain commodities such as petrol and other flammable or dangerous liquids, explosives and combustible traffic, dangerous chemicals and radio-active materials, to mention but a few While some of these are not permitted together on the same train, they all have to be marshalled at a minimum (safe) distance from the locomotive/rear end of the train and separated from incompatible traffic

Apart from the foregoing, "abnormal loads" (i e loads of extraordinary dimensions or mass) have often to be conveyed by rail Such traffic is normally conveyed on special vehicles built for the purpose, and must be marshalled (attached) just behind the locomotive so that the driver can regularly watch the running thereof and ensure that it is running safely He can also, if circumstances demand that this be done, stop the train and carry out personal inspections In the case of vehicles with abnormal dimensions, he must establish whether it will be able to pass through all structure gauges and, in the case of vehicles with abnormal mass, ensure that the mass is within the maximum permitted on certain sections of the line and over certain bridges Any restrictions imposed on one vehicle, for whatever reason, applies to the whole consist of vehicles

From the foregoing it will be quite evident that it is of vital importance to a driver to know exactly what classes of traffic his train is conveying, and what restrictions are applicable over the section/s his train is required to run This information is also vitally important in the case of accidents/incidents, in order that the correct arrangements can be made for the clearance of such traffic

NOTE 1: The shunting staff responsible for making up (marshalling) the train load, are responsible for ensuring that the train load is correctly marshalled in every respect and that all the restrictions applicable to the section/s over which the train is required to run, have been taken into account

NOTE 2: Different loading specifications exist for the different classes of traffic conveyed, and the employees concerned must ensure that the vehicle loads conform to those specifications

6.2.2 The infrastructure must be trainworthy

This simply means that every technical appliance, structure or facility required for train and shunting movements must be technically sound and safe to accept (allow) such movements (It must be "worthy to accept the train" = trainworthy)

The track, i e rails, sleepers, points and crossings, the track bed (groundwork and ballast), bridges and culverts, must all be up to standard so as to ensure the safe passage of the train Likewise the structures alongside and above the track must be within the structure gauge - which means they must be so spaced and positioned that a train or shunt will be able to pass safely through This includes bridges, the overhead power lines - in the case of electrified sections - signals and electrification masts, cables, walls and buildings, etc, and adequate communication facilities must be available

6.2.3 Authority to be issued, accepted and "handshaken"

Here are two aspects to be considered

In the first instance the traffic controller or other authorised employee concerned, and he only, is empowered to grant (give, issue or hand over) an authority for a movement to take place within the area under his control or area where he is authorised to do so However, and in spite of what has already been said about those employees' and the driver's responsibilities in this regard, it must be repeated that the employee concerned must make absolutely sure that the wording on the token, or the wording of his oral authority, is clear in every respect, that it is unambiguous and that there will be no likelihood whatsoever that the driver will not know exactly what is expected of him Secondly, the driver must ensure that he receives such authority, and that he is absolutely clear on what he is expected to do, and that there is no likelihood of his misunderstanding any aspect of the authority before he starts moving or, when he obtains his token (authority) while passing through a station, before entering the section ahead The authority must, therefore, be correct in every respect The way traffic controllers and drivers can ensure the foregoing, is by way of "handshaking" the authority

How can an authority be "handshaken" and what is the significance of this? Well, what is the significance of any handshake?

Normally, when one person shakes the hand of another, it is to solemnly seal an agreement (deal), to greet the other person or to sympathise with the other person, etc In all such cases, however, there is positive contact between the two persons

Handshaking of authorities can, therefore, only be accomplished when contact can be made between the two employees concerned, for instance the traffic controller and the driver This "contact" does not have to be a physical handshake It can be done orally, either face to face or by telephone or radio What is important, however, is that the driver must - and must be able to - acknowledge having received the authority and he must repeat the authority to the employee giving or issuing it, and the latter must ensure that, when the driver acknowledges and/or repeats the authority, the driver's version of the authority is correct in every respect This, then, is called the "handshaking" of authorities, which is meant to ensure that the movement will be carried out as intended Accepting and "handshaking" an authority is acceptance of responsibility for its execution

6.2.4 Know location, extent and limitation

This principle applies mainly to traffic controllers and shunting yard staff, and the importance thereof is that such an employee must <u>at all times</u>, before authorising any movement, establish, by the technical or other means at his disposal, the exact location of the train or shunt that is to be authorised In the case of a shunting yard where authority is given orally or by means of a hand signal, the position of the train or shunt is normally readily known, as the oral authority is given to the driver - in person - either at the locomotive or by radio (walkie-talkie) from nearby When a signal is to be operated for a train movement from a shunting yard, it is not so easy for the traffic controller to personally establish the exact position of the train and whether the movement will be safely carried out because yard tracks are not track-circuited (If they were track-circuited he would be able to obtain the information from the indications on the panel) In such an event he must obtain the assurance from a responsible yard employee, at least the one who has been assigned this duty and who has been certified, to the effect that the movement will be safely carried out should the traffic controller operate the relevant signal, i e that the relevant hand points have been correctly set, etc

In the case of a colour-light signalled area (excluding a shunting yard), the traffic controller responsible for operating a signal can easily establish the position of the train, because of the fact that the track is track-circuited and the position of trains, signals and points is displayed on the illuminated panel in the control centre from where the traffic controller operates the relevant push buttons This enables him to pinpoint the position of a train, on condition, however, that there hasn't been a power failure or a failure of the equipment, in which case the indications on the panel will either also be "defective" - displaying red lights - or the panel will be "dead" - displaying no lights at all It is in such cases that the traffic controller must be very careful and be able to establish, without a doubt, where the train is standing, before authorising the train to proceed As such authorities are transmitted orally, "handshaking" is of the utmost importance It must further be emphasised that the persons issuing and accepting an authority, must have a clear understanding of and be in agreement with the full extent of the intended movements

A number of "limitations" can be brought to mind Limitations, for instance, that a traffic controller or the shunting yard employee who authorises shunting movements, should be aware of, and limitations that a driver should be aware of But this in no way implies that only a driver and the aforementioned employees must be aware of certain limitations Each and every employee must make it his duty to ensure that he takes into account all limitations that are applicable in the execution of certain duties or the putting into motion of certain actions Take note of the following examples

(i) The responsible yard employee must, when making up a train load, know the exact maximum number of axles (i e the <u>length</u> of the train) that can be accommodated in the shortest running line required for crossing or passing of trains en route to the destination of the train, and limit the length of the train accordingly

(ii) A driver must, when taking charge of a train, ensure that the mass of the load (i e the total tonnage) falls within the tractive effort of the train locomotive/s, i e he must ensure that the train is not "over-load", and that there is sufficient brake power in relation to the mass

The following are further limitations that could influence safe and/or efficient train and shunting operations

- insufficient time to carry out a movement
- adverse weather conditions
- yard/traffic congestion
- insufficient line/yard capacity
- poor visibility
- insufficient manpower

NOTE: The maximum loads for the different classes of locomotives or combinations of locomotives are laid down in the locomotive load tables and in the Working Time Book

6.2.5 Consider feasibility of execution

This simply means that, to mention but two examples -

(i) Before the responsible employee authorises a train or shunting movement, he must ensure that the movement can be carried out - completed - without causing delays to other, more important, train or shunting movements, and without creating dangerous or unsafe conditions For instance, a goods train arrive at a single line station where it has to detach vehicles containing traffic for that station and, say, the shunting movement has to be carried out on the main line Now, should a more important train be expected to arrive at that station from the station in advance, say, in fifteen minutes' time, a delay could be caused to that train or, worse still, a dangerous condition could arise by allowing the goods train to shunt out of the station in the face of the oncoming train, should the traffic controller wish to complete the shunting before the arrival of the train He should, therefore, in order to ensure safety, delay the shunting work until such time as the train has arrived

(ii) Before a driver sets his shunting movement in motion, he must ensure that, as far as he is concerned, the movement can be safely carried out, by checking out the "technical" details, such as brake power available, length of load, up/down gradients, ability of class of locomotive to handle the load, and other circumstances that will assist him to assess whether or not it is feasible to obey the "command" of the train controller

6.2.6 Have continual communication

What "communication" is referred to here? Well, without a doubt communication between the employee in charge of or authorising the movement, and the driver, the one who gives (or gave) the authority and the one who receives (or received) it "Continual" communication is, however, not always possible, but what is meant is that they must, as regularly as possible, make contact with - and speak to - one another This is of the utmost importance for safe and efficient working, and applies equally to train and shunting movements, and can be best put as follows

- Wherever and whenever possible there must be regular communication, in whatever form provided, between all persons concerned with train and shunting movements, and with persons working on or near the line, in order to ensure that train and shunting movements will be carried out safely and efficiently, e g

  * when drivers are provided with radios or any other means of communication, traffic controllers, yard staff and other employees concerned must work in close collaboration and regularly communicate with the driver, especially while movements take place,

  * where hand signals are used during shunting operations, such hand signals must be regularly displayed so that the train staff will be continually aware of what is expected of them

6.3 AUTHORITY

6.3.1 Shall be issued and accepted only by licensed persons

To start off with it must be emphasised that an authority must be issued/given in the prescribed format Furthermore, the employee giving (issuing) the authority (normally the traffic controller or responsible yard employee), as well as the employee receiving it (normally the driver), must be <u>"licensed"</u> But what does this mean? Well, <u>let us first consider what it does not mean</u> It does not, for instance, mean that the employee concerned is licensed because he has undergone training, and that he possesses a certificate or diploma to prove that he has passed the relevant examination/s Think, for instance, of someone who is sent to College to follow a train working or any other course which consists mainly of theory On passing the exam he will probably be able to recite many passages of theory, but he will not be able to take over and run a control room, train control office or shunting yard Until such time, therefore, as he has had ample opportunity to learn all aspects of the practical work - <u>under practical conditions</u> - and has been put to the test and been certified competent to safely undertake the duties to be assigned to him, he cannot and may not be "licensed" to perform such duties While having a certificate - i e being "certificated" - has <u>permanent</u> features, in that it is proof (in writing) that one has fulfilled the requirements of that specific examination, "licensed", although pointing to the competency of the person and having a <u>temporary</u> feature, carries more weight than having a certificate

The certificate proves that one has sufficient theoretical knowledge of the job, while being licensed says that one can also do the job An employee must, therefore, not only be qualified, but also licensed!

6.3.2 Shall have one meaning only

The principle means that the recipient must have no doubt as to the correct meaning of an authority, and that it shall be interpreted by all parties in the same way, in order to ensure uniformity and safe and efficient working Authorities can be visual, tangible, audible or oral They must be clear and to the point, must have the same interpretation by all persons involved, and must be in accord with the prescribed format and interpretation

Authorities can be misinterpreted if not given unambiguously In the case of verbal authorities the traffic controller or other employee giving authority for a movement must be very careful with his choice of words, to ensure that the driver or other member of the staff who receives the authority, will have absolutely no difficulty in understanding exactly what is being conveyed to him The recipient (the one who receives it) must repeat it to the traffic controller or other employee giving the authority, and the latter must ensure that his message (authority) was correctly understood by the recipient In this way "handshaking", which is aimed at having only one intended outcome, is achieved

6.3.3 Shall not allow conflicting (following or opposing) movements

A conflicting movement is a movement that can lead to a head-on, side-on or rear-on collision, i e the train or shunt will come into "conflict" with another train, a shunting movement or with vehicles occupying the track on which the movement has been authorised, unless timeous action is taken to prevent it

Employees whose duty it is to authorise train or shunting movements, must under no circumstances authorise any movement until they have made absolutely sure that the line on which a movement is to be authorised, is both correctly defined and clear for the movement to be safely carried out Before an authority is issued, therefore, the employee or employees concerned, must display extreme caution and carefully plan, check and re-check to ensure, without a doubt, that no conflicting or irregular movements will take place Such conflicting or irregular movements can involve a stationary or moving train or shunt, stationary or moving rolling stock, or an obstruction on, adjacent to or above the track Only after taking all the necessary precautions to ensure absolute safety may the employee concerned issue the authority

Technology is often used to prevent conflicting or irregular authorisations, and thus irregular movements, for instance

(i) a token (also referred to as a tablet) withdrawn from an instrument (machine), namely a Van Schoor token instrument (also referred to as a "tablet instrument"), is designed to be absolutely safe, as it is possible to withdraw only one token (tablet) at a time from the instrument at one of the two stations concerned And that token must be returned to (locked away in) one of those instruments before another token can be removed,

(ii) a colour-light signal cannot be operated for a train movement if the track between that signal and the next is occupied by a train or a vehicle Therefore, if the signal has been operated (to display a green or a yellow light), it is a definite indication that the line between those signals is clear,

(iii) a wooden staff handed to a driver on a wooden staff section where paper tickets are not used, is an assurance to him that the line between that train control station or token station and the next train control or token station is clear of trains, as there is only one wooden staff available between any two stations

6.3.4 Holds good until executed or surrendered/withdrawn

The "authority" referred to here is any kind of authority given, obtained or issued to authorise a train or shunting movement, while that it "holds good until executed (i e reached the intended limit of the movement) or surrendered/withdrawn" simply means the following

(i) Should a signal have been operated for a train movement, the "authority" given by the green or yellow light holds good until the "movement" has been executed, i e the train passes the next signal But if the train comes to a standstill somewhere between the two signals, is unable to proceed, and the driver requests the assistance of an assisting locomotive to clear his train from the "section", he surrenders his authority the moment he requests assistance and his request will be "handshaken" by the signal ahead being returned to "danger" Thereafter he may only move when granted a new authority to do so

(ii) Should a train fail in a section when proceeding on a token, the driver must surrender it (hand it over to a responsible employee or stow it in a safe place) when he requests or sends for assistance

(iii) If the driver does not request assistance - e g if the train movement is normal - he must hand over (surrender) the token to the traffic controller at the next station, or, when inter-working has been arranged, to the train staff of an opposing train at the next interloop, i e at the limit of the movement, or the end of the defined track

Remember: In this case the token is his <u>authority</u> and therefore he hands over his "authority" or stows it in a safe place

(iv) When is a token "withdrawn"? Well, it can be withdrawn by the traffic controller at the starting station if the train fails to depart at the appointed time and, as a result, the arrangements have to be cancelled and new arrangements made It can also be withdrawn by an official who is sent to a "failed" train or a train involved in an accident and assistance has been requested, etc Likewise, <u>written</u> or <u>oral</u> authorities can also be "surrendered", "withdrawn" or "cancelled" when circumstances demand that this be done

6.4 BEFORE MOVING

6.4.1 The track must be defined

What does this actually mean? And which "track" - or portion thereof - is being referred to?

Since a <u>movement</u> is to take place, it must surely refer to the boundaries, or limits, of the track or portion of track over or on which the movement (train <u>or</u> shunting movement) is to take place All will agree that the driver of a train or shunting movement cannot be given - as it were - a blank cheque to move, without an indication of the limits of the movement That means that <u>the driver must know</u> from exactly where to exactly where and over/via which route he may move, and when this <u>distance and route</u> he may/must travel, is known to all the involved personnel and understood by all involved in the same way, it can be safely said that the track has been "<u>defined</u>"

In the case of a train movement the defined track can be a whole section, i e from a station to the next station, crossing place or halt, etc , or even to a point in the section, as will be indicated on the <u>token</u>, or it can be from one signal to the next In the case of a shunting movement the defined track can extend over just a few metres What is of the utmost importance, however, is that all those concerned must know the exact limits before the movement takes place The traffic controller, the employee who normally authorises train movements, or the yard employee/shunter, the one who authorises <u>shunting</u> movements must, before issuing or giving the authority, himself have absolute clarity on the "limits" of the movement When two or more employees are concerned in defining the track/line, they must all be in agreement

But it is not only <u>people</u> who must/can "define" the limits of a movement, as it can also be done by "technical" means, e g by means of a <u>signal</u> which, when operated (placed at "all right" or "proceed"), normally authorises a movement to the next signal, especially in the case of train movements The defined track or portion of track is thus, in this example, from signal to signal

6.4.2 The defined track must be clear

It is the responsibility of the traffic controller, yard employee, etc., to ensure that, before he authorises a movement, the portion of line over which the movement is to take place (the defined track) is clear of trains or vehicles or other detectable obstructions, and that, where points are situated in the defined track or the route over which the movement is to take place, the points are correctly set, where possible, before the movement is authorised For instance

(i) If a train has to proceed from one station/crossing place/interloop to another, the "defined track" will be that portion of the line extending from the station/crossing place/interloop of departure, up to the first stop signal - or where there is no stop signal - up to the the next station/crossing place/interloop

(ii) If a locomotive is despatched to clear a failed train from a section - should it (normally the locomotive) have failed and cannot proceed - the defined track will extend from the place of departure of the assisting locomotive up to a point short of the failed train This is the limit of the defined portion of the track, and will be reflected on the driver's written authority he receives (or writes himself) before departing

(iii) For a shunting movement to take place in a station or shunting (marshalling) yard, the yard employee authorising the movement must ensure that the portion of line over which the movement is to take place, either to detach or to attach a vehicle/s, is clear for the movement to be safely carried out That portion of line - even if it is only a few metres - is then the defined track Just think of the definition of "shunting" which states, inter alia, " or the movement of trains or vehicles within the shunting limits" And how are the limits prescribed? By the oral or written instruction/authority the driver receives to carry out the movement

(iv) If a train has to proceed over a colour-light signalled section, the defined track will extend from one signal to the next (No matter what light the signal displays, it can never be an authority to pass the next signal!) The mere fact that the signal displays a green or yellow light, is an assurance to the driver that the line between that signal and the next signal is clear, and it is also his authority to proceed to the next signal (Although a signal can give a driver information regarding conditions beyond the next signal in advance, it cannot authorise him to pass that signal)

(v) Where there are points within the defined track they must, where possible, be correctly set before the movement is authorised.

Remember - if it cannot be established, without a doubt, that the defined track is free of detectable obstructions, no movement may be permitted over that defined track

(vi) When a driver receives an authority to move, he must ensure, as far as he can see, that the line is clear within the structure gauge, and this he must continue doing while the train is in motion

6.4.3 Issue/obtain authority

All railway lines - even sidings that are seldom used - are under some or other form of control That means that a licensed person is in charge of such line/s and that no train or shunting movement may take place on such line/s without the permission of that "someone" Such permission or authority may be given in a number of different ways (where applicable in the prescribed format), e g orally (face to face), by telephone, by radio, in writing, by means of a token or by controlled signal or hand signal However, although a licensed person is in charge of lines for the movement of trains or for shunting operations, a signal that has been operated for such a movement becomes the driver's authority to move - and such signal tells the driver how far he may go before receiving a new authority Likewise, when a driver receives a token (there are numerous kinds of tokens used under the different train control systems on single lines), such token, too, will inform him how far he may proceed and under what conditions The driver of a train or shunting movement may not move on any line or portion of line without such authority. Normally a separate authority must be issued/given for each movement, but one authority can, if circumstances so require, combine two or more movements

6.5 WHILST MOVING

6.5.1 Adhere to speed instructions

Train staff, especially the driver, must take special heed of speed instructions This is of vital importance for the safe running of the train and its traffic/passengers There are various speed restrictions and speed limits to be observed by drivers It is important to remember, however, that speed-limit boards are normally track-related The physical conditions of the track, i e curves, badly-worn or defective rails or sleepers, all call for some or other speed limit, which will be determined in accordance with the prevailing conditions Some speed limits, like those imposed on curves, are permanently imposed and the maximum speed allowed is indicated on permanent speed-limit boards, while speed limits of a temporary nature (imposed due to the condition of the track or while repairs to the track are being carried out) are indicated on temporary speed-limit boards

The speed of trains over points and crossings is restricted, and the maximum speed varies in accordance with the class of rail and the nature or the type of locking with which the points are provided Drivers learn and must know the different speeds applicable to points and crossings, and can determine the maximum permissible speed from the signal layout - or the absence of signals - as well as the signals operated for the train movement When temporary speed restrictions are to be enforced for any length of time, a speed-limit notice is issued to inform all members of the staff concerned with the running of trains over that particular section This, however, does not eliminate the necessity of using temporary speed-limit boards

It must also be remembered that certain types of vehicles, or certain classes of trains, or certain classes of traffic on trains, as well as "dead", i e inactive, locomotives on trains, call for speed restrictions

6.5.1.1 Stopping distance of trains

As a general rule, any train must have sufficient train-braking ability to enable it to stop within a distance of 1,500m under all circumstances This norm is used for determining signal placings, and for the protection of maintenance crews Signals, however, can be placed at shorter distances where gradients aid train retardation

In order to conform to the stopping distance norms, and depending on train and route profile, various restrictions have to be enforced These restrictions include limitations on average train-axle loading, general and down-grade speed restrictions, special prescribed train-handling methods, and minimum train-braking power requirements

Although 1,500m is the absolute norm, variations in the mechanical condition of equipment, co-efficient of friction of brake blocks, wheel temperature, adhesion and train handling, in general, necessitate a more conservative design norm

6.5.1.2 Permissible train speed

The maximum permissible train speed is dependent on various factors, such as

Vehicle speed
The maximum safe speed of a rail vehicle depends on various parameters From a stability point of view, the type of bogie, wheel profile and maintenance standard play a role In the case of vehicles fitted with plain bearings, the risk of hot axle boxes increases with increased speed and axle loading Although individual vehicles have an inherent safe vehicle speed, additional factors have to be taken into account when vehicles are made up (coupled) to form a train As a general guideline, the following vehicle speeds are applicable

-	Wagons fitted with roller bearings	80 km/h
-	Wagons fitted with plain bearings	60 km/h
-	Passenger coaches	90 km/h

Train speed
When vehicles form a train, the characteristics of the vehicles on the train determine the maximum speed

In general, the following maximum train-speed categories are applicable

-	Vacuum-braked trains	60 km/h
-	General air-braked trains	80 km/h
-	High-speed goods trains, axle load restriction of 15 tons, specially selected wagons, air-braked wagons	100 km/h
-	High-speed goods trains, axle load restriction of 12 tons, specially selected wagons, special maintenance standards, air-braked wagons	120 km/h
-	Passenger trains	90 km/h
-	Blue Train	110 km/h
-	Light locomotives (locomotives running "light", i e without a load)	60 km/h

Traffic controllers must take all speed restrictions into consideration when arranging for trains to cross or pass one another

Speed restrictions are also to be applied and observed during shunting operations But how?

Well, there are a number of aspects the driver must take into consideration, e g , the length and weight (mass) of the load, the class of locomotive and the nature of the brake power, the number of vehicles on the load with the brake coupled through; whether the line is on a falling gradient, on level ground or on an incline, whether there are curves in the line that could obstruct the view on the leading vehicle and/or shunting staff, the distance - defined track - over which the movement is to take place, etc While the foregoing refers to technical/physical aspects, drivers must at all times obey the hand signals of the shunting staff and regulate the speed of the movement accordingly

6.5.2 Adhere to trackside and other indicators

Trackside and other indicators provided for the information of the train staff, but especially for the information of drivers, too, call for special attention to ensure correct train handling and safety Think for instance of gradient boards that indicate to a driver whether his train is travelling on level track or is about to negotiate on uphill or a downhill - and how steep the gradient is A driver who ignores such boards could be faced with his train coming to a standstill on a steep up gradient or, worse still, with his train running away on a down gradient

Whistle boards are also provided for the purpose of ensuring safety Not necessarily the safety of the train itself - although we cannot exclude trains - but the safety of road users requiring to cross the line at level crossings, i e drivers of road vehicles and pedestrians

Other trackside indicators are axle-counter indicators, "CTC" or "End of CTC" boards, etc , as well as controlled signals, hand signals displayed by technical staff working on or in the proximity of the track, etc Apart from trackside indicators there are also overhead indicators such as signals and electric traction indicators, while it is quite likely that indicators could, in future, be provided in locomotive cabs for the information of drivers

It is not necessary to list all indicators here - it will be done in another publication - but what is important to remember is that they are all provided to ensure safety and efficiency in train and shunting operations and must, therefore, be strictly obeyed

6.6 STOP

6.6.1 At limit of movement

As we have seen under principle 6 4 1, the track must be "defined" - it must have a beginning and an end or definite boundaries or limits And it is at the end that the driver of a train, or shunt must stop the movement, i e at the limit of the "defined track", as prescribed by his authority However, when we say that the train or shunt must stop at the limit, it does not mean that the driver may ignore limitations such as a "danger" signal, i e hand signal, red banner, etc displayed en route, or that he may ignore dangerous conditions, such as washaways, trees blown across the track, etc It merely means that he may not proceed beyond the point to which he is authorised to proceed And he must stop there unless, before stopping, he receives a new authority to proceed over the next "defined track"

6.6.2 When and where scheduled

This applies not only to passenger trains, but also to other trains and to locomotives, with or without vehicles attached They can be scheduled (booked) to stop at specific places for passengers, traffic or other purposes. Although a train may not be scheduled to stop at a certain place, it can be arranged (preferably in writing) to stop there In the case of trains running on main lines, such schedules are laid down in working time books or in special train notices (when such train is a special train, i e an additional train not provided for in the working time book or time-table) In other cases it can be a local working procedure However, if a train is scheduled (booked) or arranged to stop at a station, etc , it must stop there

6.7 WHILST STATIONARY

6.7.1 Stand clear (not foul)

The front of the locomotive of a train, or the front of the locomotive or leading vehicle of a shunt must, when brought to a standstill in a station or shunting yard, not be allowed to stop beyond the clearance mark of the adjoining line Failure to obey this principle will inevitably lead to an accident - sometimes with tragic consequences The same procedure must be followed when a vehicle or vehicles are detached on a running line or in a siding In other words, trains or vehicles standing on one line must not form an obstruction for trains or vehicles having to pass on the adjoining line and must, therefore, not be left standing beyond the clearance mark, i e on that side of the clearance mark nearest to the points Where catch points or a derailer is provided, trains or vehicles must stand on that side of the catch points or derailer which is furthest away from the points giving access to that line

6.7.2 Be secured (against movement)

Whenever a train/shunt/vehicle is at a standstill, it must be secured against irregular movement! This purely means that <u>it must not be able to move</u> It may also not be moved without authority

When a train, or a locomotive with vehicles attached - e.g a shunt - comes to a standstill, the relevant brakes, i.e. locomotive and/or vehicle brakes, must be applied for as long as the train or the shunt is required to remain stationary In addition, should vehicles not be coupled to a locomotive, train or shunt, be left standing, sufficient hand brakes must be applied and, where necessary, a scotch/es placed under the wheels

6.7.3 Be protected

The protection of trains and shunts will not be discussed in detail here as there are numerous ways of affording such protection Suffice it to say that trains standing on running lines in the section are more often than not protected by means of detonators (placed on the line) and hand signals Trains, shunts, or vehicles standing in yards or signalled areas, on the other hand, can be protected in different ways For instance, when they are at a standstill, by setting the points for another line to prevent other movements colliding with it. They can also be protected by placing and keeping the relevant signals on either side at "danger" and by the use of "reminders" in train control centres/stations to remind the traffic controller not to operate certain signals and points

Whatever measures are taken to safeguard trains, shunts or vehicles against collisions, can be regarded as "protection"

6.8 COMMON TO ABNORMAL CONDITIONS

6.8.1 Have a hierarchy of fall-back procedures

A "hierarchy" means, according to the Oxford Dictionary, "a system in which grades of status or authority rank one above another", while "fall-back procedures" refer to the steps or actions to be taken when something untoward happens These steps or actions must be taken in a certain order or sequence and this then is the "hierarchy of fall-back procedures" One example will clarify what is meant by this principle

Take the Van Schoor Train Token System of train control, for instance, where "tokens" or "tablets" are withdrawn from a token instrument as an authority for a train to proceed to the next station Now, should the token instrument/s fail (and all else is in order), telegraph order working (in future it will be called "paper order working"), in terms of the existing instructions, must be introduced Should speaking communication (telephones, radio required to make the arrangements for telegraph order working) thereafter also fail, emergency working must be introduced to control train movements over the section In other words, there is a definite order in which the "fall-back procedures" must be introduced

All employees concerned with the running of trains must have a common understanding of the fall-back procedures to be followed when failures, irregularities, etc occur, in order to ensure uniformity of action and continued safety.

SELF TEST

1 Give a definition for

- 1 1 "Authorise"
- 1 2 "Continual communication"
- 1 3 "Defined track"
- 1 4 "Handshaking"
- 1 5 "Infrastructure"
- 1 6 "Protect"
- 1 7 "Serviceworthy"
- 1 8 "Token"
- 1 9 "Trainworthy"
- 1 10 "Vehicle" (20)

2 Name five of the Principles for Safe Movement on Rail (5)

3 What do you understand by personal behaviour? (9)

4 Name the six principles relating to movement (6)

5 Briefly explain the three factors which make up an authority (20)

6. What must be done.
- 6 1 Before moving? (3)
- 6 2 Whilst moving? (4)
- 6 3 Whilst stationary? (3)

7 When and where must a train stop? (4)

8 What is meant by fall-back procedures? (6)

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International Rail Safety Conference

1997 LUCERNE

21 May - 23 May 1997
Swiss Transport Museum, Lucerne, Switzerland

Paper 9717

Dr Ch. Lienert

Risk Scenery at Swiss Railways

Publisher
2000 International Rail Safety Conference

Schweizerische Bundesbahnen
Chemin de fer fédéraux suisses
Ferrovie federali svizzere
Swiss Federal Railways

INTERNATIONAL RAILWAY SAFETY CONFERENCE (IRSC) 1997
21 to 23 May, Lucerne / Switzerland

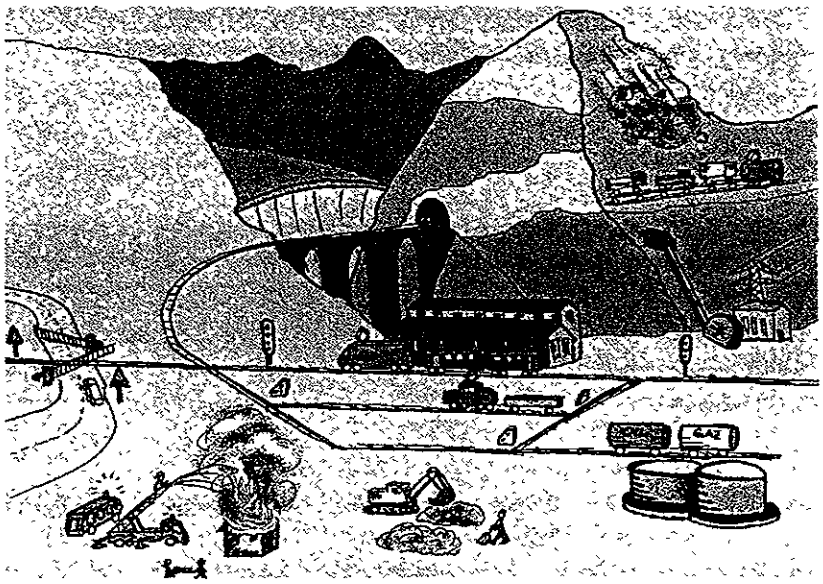
PAPER:	**Risk Management** **Risk Scenery at Swiss Railways**
PRESENTED BY:	**Mr. Dr. Ch. Lienert** **Risk Manager**
DATE:	**22.05.97**
SESSION:	**V**
TIME:	**0900-0930**

The Swiss Federal Railways Risk-Scenery

by Dr. Ch. Lienert, Safety-Division, Swiss Federal Railways

1 Risk Scenery

Risk-Management is generally defined as "the protection of a company's assets (physical, financial, human) against loss and damage in the most cost effective way". This implies that a company is a unity of single, but integrated parts influencing each other. Nevertheless, risk was and is assessed often in isolated cases. Since several years Swiss Federal Railways made a effort to establish an integrated Risk assessment, at least in the field of technical risks, but more and more in other sectors too. Sure, beside the technology, all other activities and the environment are containing risks, which may threaten a company, and have to be taken into consideration (human resources, markets, projects, politics etc.) to draw up the companies risk-scenery, but my talk today is confined to the technical dimension. The overhead shows a simplified picture of what I call the technical dimension of the risk-scenery.



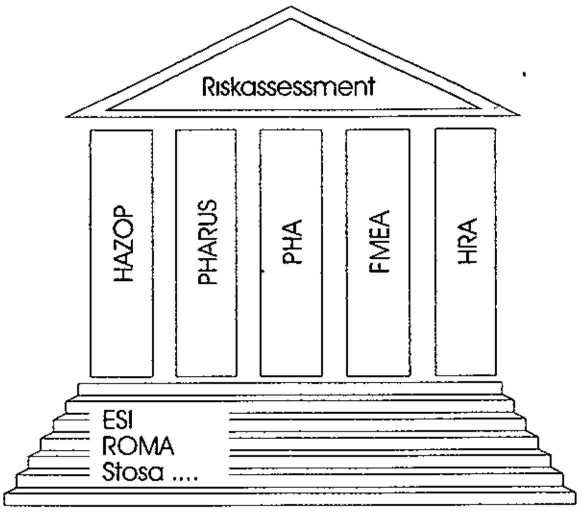
In a first part I would like to present the theory behind our approach and than two examples, how we applied the theory to specific problems.

Many single parts, indicated on the overhead, build up a network, which may be simply called "railway-traffic". I would emphasize the term "network" because it's the simplest explanation of our approach. The network is something complete, so it s obvious to deal with the network and not only with separated parts of it. This does not mean, that we are take the whole system into account for every single risk analysis, but we try to assess the risks in a homogeneous scale. I would like to explain this a bit further.

2 Methods

To optimize the resources (human, financial etc.) the technique of every risk analysis must be adequate for the given problem – that is to say the right method for the right task and with the right depth of focus. To reach the goal mentioned before, two things are indispensable.

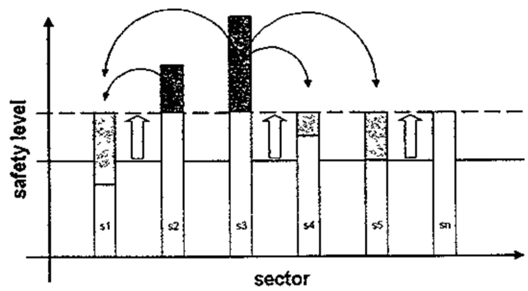
First - the foundations: the database must be equal for every method. Especially here railways in general and the Swiss Federal Railways particularly - as a quite small company – have only a sma1l database available. Two reasons stay in the foreground. First, rail is undisputed one of the safest transport on earth and second, the time-window for statistics is not too wide because the technical progress is quite fast. Therefore we just took a new developed database in operation in which we collect all security and safety related data all over the company – not only data of events but also data of near-misses. Other sources we use, are for example databases in the range of the rolling stock and the signaling devices etc.



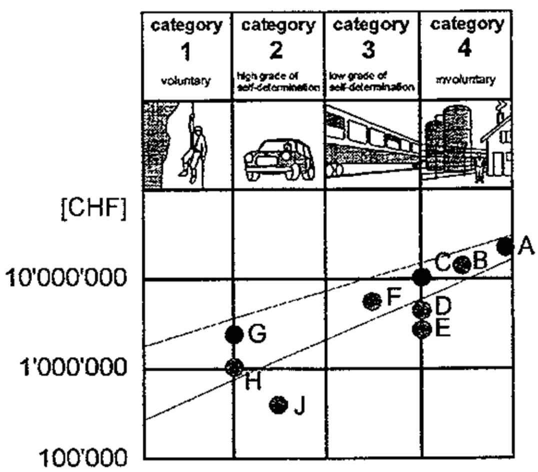
Second: If we have analyzed a risk, we have to make it comparable in our risk-scenery. This is not so easy because possible damages are very different. It may be dead or injured people, evacuation, pollution of air, soil and water or simply a financial loss.

3 Goal

Goal of all efforts must be to establish a overall safety-level in our risk-scenery. Therefore a check of every element and of every sector must be performed. Economical principles have to be applied to support the best possible safety-level in the network. "Best" means definitely not the "maximum" - because nobody can afford it - "best" means simply the "optimum", according to the economic efficiency.



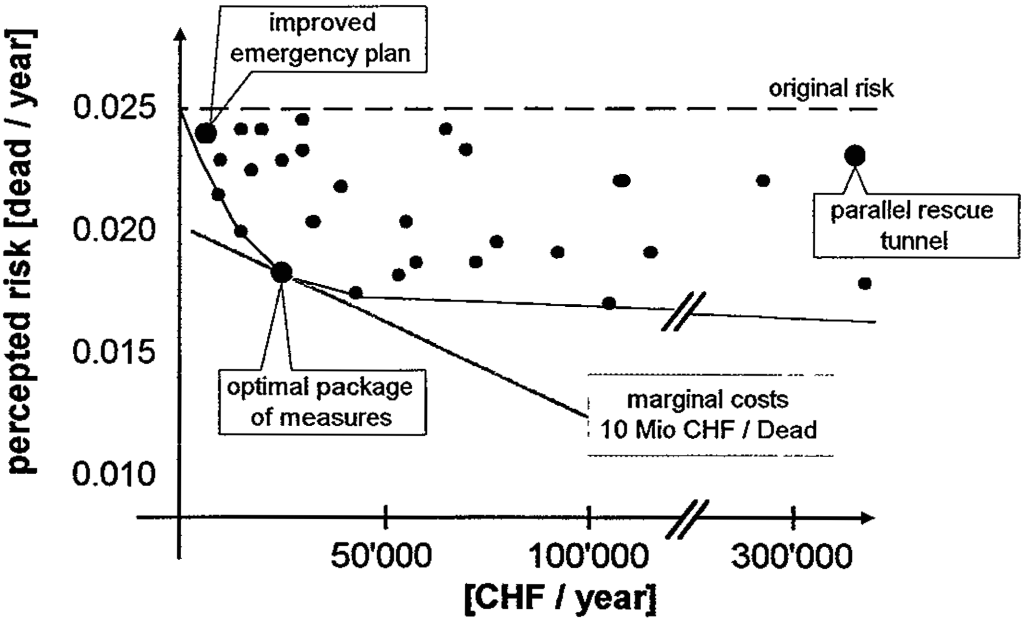
4 The way to make risk comparable



A SBB fire and release of DG
B ÖBB (1993)
C SBB derailments and collisions
D USA air traffic
E DB Tunnel (1982)
F British Rail (1992)
G SBB industrial accidents
H DB level crossings
J USA road traffic

Marginal costs are a indispensable tool for a adequate Risk-Assessment. They specify the amount of money which one is willing to spent to save a life. With this value it is possible to check if measures or packages of measures are appropriate or not. Unfortunately it's not so easy to find values which are accepted by all persons concerned. For a economist the values are often to high because he argue that railway is already very safe. The public and the authorities have a different point of view. There are also moral and ethical questions touched. If every human being all over the world has an equal worth, is a philosophical question and has no importance for a national company, which knows only "railway-users" or "customers". More difficult to answer is the question if a employee has the same worth like a passenger or passengers have the same worth in every situation, but this is a topic for another lecture.

When a human life is involved, it's very difficult to associate an amount of money with it. Sometimes definition of a financial value of a life is refused because of moral reasons, even this is the way every insurance company is calculating its premium. I remember a remark of a friend of mine in this context: Every amount of money for a human life is wrong, but at least it's less wrong than zero. We belief marginal cost are indispensable for a funded discussion which has the goal to achieve a homogeneous safety-level in a system.

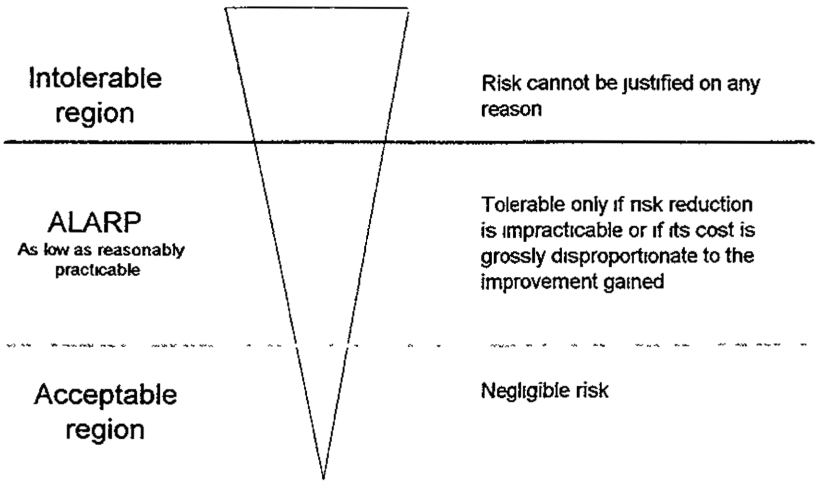


Nevertheless, use of the marginal cost criterion offers a possibility to compare all different risks in a homogeneous scale. The way to do that is simply to convert all risk into money. The so received risk-units in CHF per year are directly comparable with the costs again in CHF per year. All measures or packages of measures were introduced in the same way. The optimal combination of measures are then situated on a envelop curve. The optimum is then simply the tangent with the slope -1.

5 Safety - goals

Nevertheless it's not possible to treat the complete discussion about safety with only the marginal cost argument. Another very important value, which has also its difficulties, is the limit of the accepted risk. Like in many other countries, Swiss authorities had stipulated safety targets or rather risk thresholds in the context of the transport of dangerous goods, but there are no risk thresholds for all other sectors where dangerous goods are not involved, like fire, derailment, collision etc.. We are just now in discussion to define safety-targets for the new trans-alpine tunnels, but obviously all other parts of our risk-scenery are affected in one or another way. So we have to be very careful because a adequate solution in one sector may be a mortgage in another.

We found that, relating to safety goals, we have to distinguish between risks due to the "normal" railway operating (fires, derailments, collisions etc.) and risks due to the transport of dangerous goods. A renunciation of this difference would cause a discrimination of railway companies which are transporting dangerous goods compared with companies without such transports This is not to reconcile with the principle of legal equality.

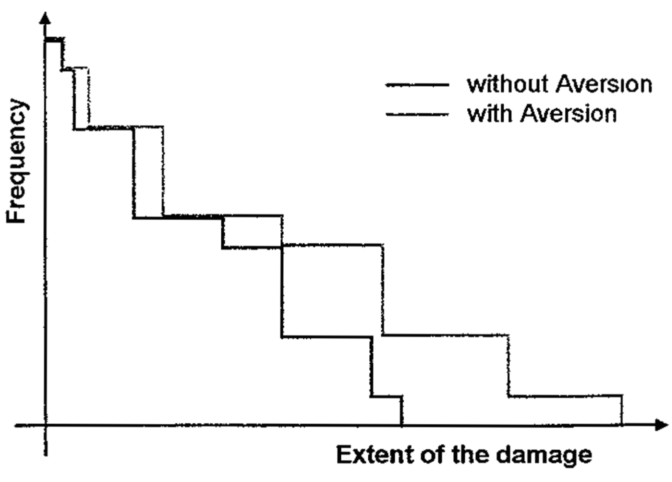


Therefore we would like to introduce quantitative safety goals for the risks due to dangerous goods. In this subject-area we have a duty by law to redevelop existing installations.

In the context of the "pure" railway-risks is no duty for a redevelopment. Therefore we define a range of acceptance according to the ALARP-area (As low as reasonably practicable). This range must be coordinated other European countries, because even Switzerland is not (yet) a member of the European community, it is not a island in the center of Europe, but integrated in a European traffic system. Inside of this range we than make use of the marginal-costs-criterion.

6 Limits of marginal costs - aversion

Marginal costs are not the cure-all to get a acceptable level of risk in a system like rail. First I should say one word about risk-aversion. It is a well known phenomena that a large accident with a high severity is estimated much worse than a number of smaller accidents with the same total extent. This effect shows, that events which were felt as catastrophes, have a influence on the evolution of technical systems, even their importance is neglectible from a statistical point of view. One example for this is the fire in a storehouse of a chemicals industry in Basel 1986. The statistical risk does not contrast to many other risks but nevertheless, it caused a above-average number of measures and regulations. But what influence has the aversion on marginal costs? For accidents with small extent of the damage the system is working satisfactory but for large scale accidents or catastrophes it's not working any more. I'll show you a example to illustrate this:



An accident has a frequency of 10^{-3} with a extent of 10 dead. With marginal cost of 10 Mio CHF / fatality the accepted costs are about 100'000 CHF / year to reduce the risk.

An accident has a frequency of 10^{-9} with a extent of 1'000 dead. With marginal cost of 10 Mio CHF / fatality the accepted costs are then only about 10 CHF / year to reduce the risk.

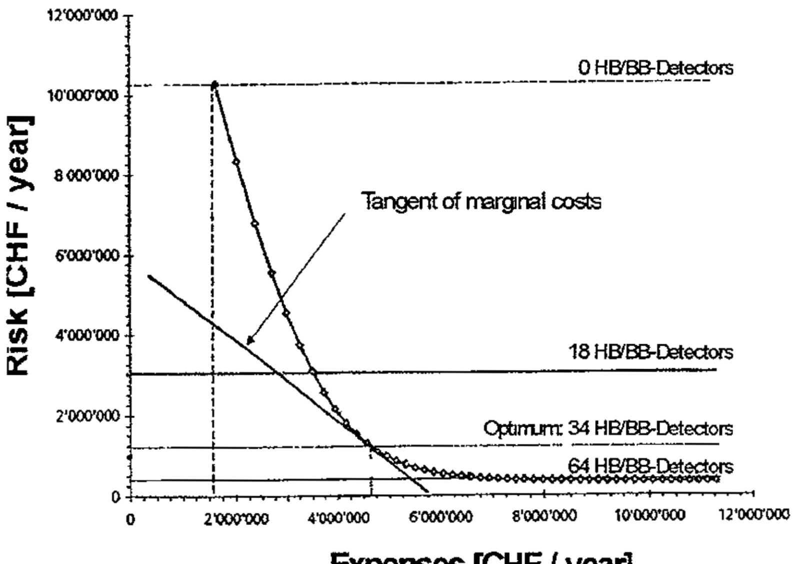
In the second case there is obviously no possibility to realize measures with this money or with other words there is no way to take precautions for catastrophes with a very low frequency.

We belief, that the marginal cost is affected in the same or at least in a similar way like the risk-acceptance-line. We attempt now to figure out what it means to combine marginal cost with aversion and what consequences we'll get. As a final result there is certainly a communication problem, because marginal cost multiplied by an aversion factor results in huge amounts of money.

To show, what we are doing concretely, I will now present a example - the network of hot boxes / blocked brakes detectors.

7 ZKE – train control detectors

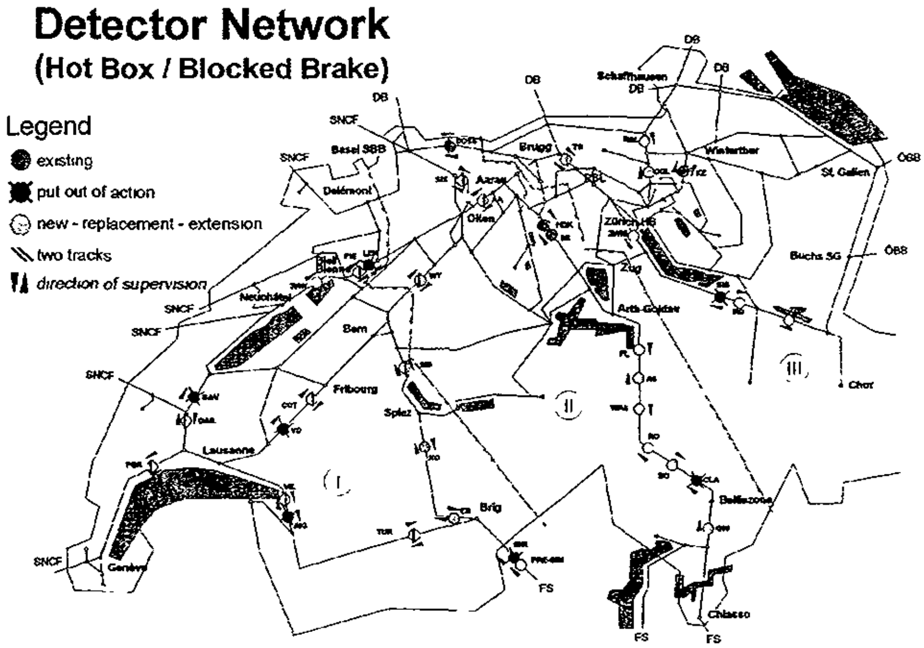
Since 1973 Swiss Federal Railways run stationary equipment for supervising moving trains. Goal of this equipment is to detect hot boxes and blocked brakes. Improvements of the reliability and availability of this equipment, changes in the operations, especially a decreasing number of occupied stations and therefore a reduced observation by the staff and some sensational accidents in 1994, lead to a "ZKE-Concept 95", which was based on a number of 64 detectors.



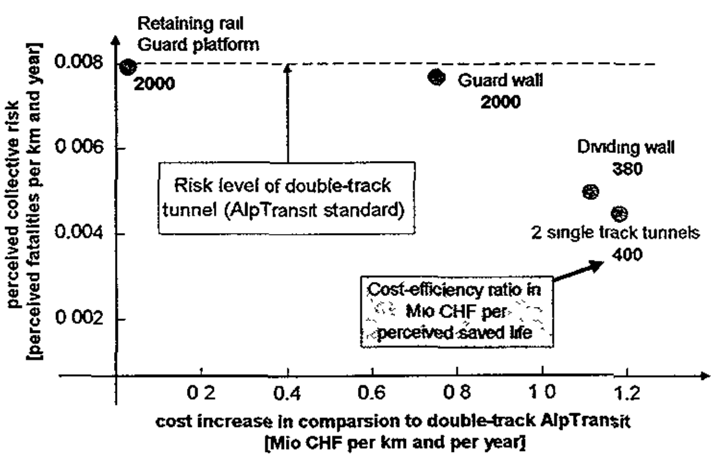
Unlike to the definitions of the length of the line between two observation points to define the necessary number of detectors - as usually done and also applied for den Concept-95 - Swiss federal railways used a different approach to check this concept. In a first step the potential to reduce the risk with this kind of equipment was worked out by reviewing the statistical bases. In a second step the effectiveness in the sense of the attainable risk reduction was estimated. In the third step the economic efficiency was judged using marginal costs an a comparison with other safety projects. Until this point we reduced the number of necessary detectors to 34 +I- 8 but no geographical arguments were considered until here. In a fourth an last step we had to optimize the locations of the detectors. Five further criteria s were applied to do this:

1: protection of the lines with a large transport volume of dangerous goods.
2: protection of tunnels.
3: protection of agglomerations.
4: protection of lines with incline.
5: availability of a place for intervention.

The result of this work was than 42 detectors or in other words, we reduced the number an therefore the costs of the detector network to about 2/3 of the fist concept. But despite this reduction we could eliminate about 90% of the risk - attainable by this sort of detectors.

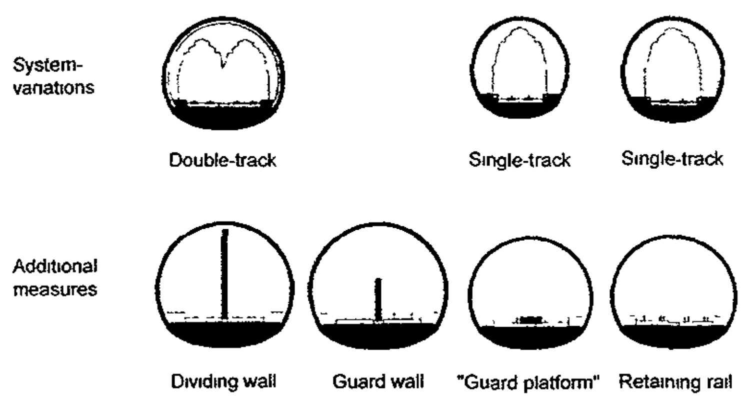


8 Double-track or 2 single track tunnels



In the AlpTransit project two tunnels on the approaching stretches with a length of 17 and 20 km are planned. One open question is, if the tunnels should be built as double-track or two single-track tunnels. Again marginal costs criterion was used to support the decision-making. Several measures were compared to find the solution with the best cost/benefit relation.

This is now an example which shows a quite clear result from the point of view of the risk management (and other topics like maintenance, costs, operation) but a bundle of demands from other communities of interest play also a important role. So the final decision, which is the duty of the authorities, is not made yet.



Final Remark

As I said before, Swiss Federal Railways are practicing this approach since several years, but the risk-scenery is far away to be complete. There are many white spots yet we have got to fill up.

International Rail Safety Conference

1997 LUCERNE

21 May - 23 May 1997
Swiss Transport Museum, Lucerne, Switzerland

Paper 9718

Tomas Persson

Banverket - Experiences of decentralised Maintenance Machine Ownership

Publisher
2000 International Rail Safety Conference

Schweizerische Bundesbahnen
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Ferrovie federali svizzere
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INTERNATIONAL RAILWAY SAFETY CONFERENCE (IRSC) 1997
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PAPER: Equipment and Engineering
Banverket - Experiences of decentralised
Maintenance Machine Ownership

PRESENTED BY: Mr. Tomas Persson
Senior Heavy Rail Vehicle Administrator

DATE: 22.05.97

SESSION: V

TIME: 0930-1000

CURRICULUM VITAE

Tomas Persson

Senior Heavy Rail Vehicle Administrator

Tomas Persson studied Mechanical Engineering at the University of Linköping, graduating as a Master of Science in 1984. He then worked as a research associate at the university, in the field of fluid power control, and finished as a Licentiate of Technology in 1989.

Tomas joined the Swedish National Rail Administration, Banverket, in 1990 and has since then been working with regulations and specifications concerning heavy rail mounted working machines.

International Railway Safety Conference (IRSC) 1997
21-23 May, Lucerne / Switzerland

BANVERKET - EXPERIENCES OF DECENTRALISED MAINTENANCE MACHINE OWNERSHIP

Tomas Persson

Senior Heavy Rail Vehicle Administrator

Swedish National Rail Administration, Banverket

SUMMARY

The experience from Banverket indicates that there is a risk of failing technical - administrative security systems if too much of the administration is changed in one step.

Before decentralisation is carried out it is important to develop rules that are flexible enough to withstand changing demands from the railway maintenance operations. This means that rules must be based on function, with respect to safety, instead of on existing technology and production needs. It is also a big advantage for the operations if these flexible rules are accompanied by detailed technical standards with descriptions of how brake systems, running gears et cetera can be carried out.

BACKGROUND

The Swedish national rail administration, Banverket (BV), was formed in 1988 from the infrastructure department of the state railway authority (SJ), as a consequence of a transportation policy decision. SJ is now working strictly as a commercial train operator, while BV is responsible for the socio-economic planning, maintenance and investments on the Swedish state's track installations. BV is mainly financed by annual government grants and the maintenance responsibility covers about 10 000 km of track.

From the maintenance machine and traffic safety point of view some very important decisions where made when BV was formed:

- the ownership of the machines should be completely decentralised to the production districts
- all central workshops where transferred to an independent company
- the head office of BV was moved to another city
- the Railway Inspectorate was established
- the market for private contractors, domestic and foreign, was opened

The idea of the transportation policy decision was to make railway transportation competitive with other transportation methods. This should be made possible by big investments in new lines and upgrading of old lines. Separating the infra-structure from the train operators also laid the foundation for future competition between train operators.

CONSEQUENCYS OF THE DECISIONS

Local ownership and maintenance of machines

The organisation regarding production equipment was completely changed as BV was formed. Before the separation from SJ the organisation was centralised and all maintenance machines, especially rail mounted vehicles, were planned and controlled from the head office. The production districts could request machines but the central administration decided if machines should be sent to them. All heavier maintenance was accomplished in a few central workshops. This caused tamping machines from the north of Sweden, to be sent in train formation more than 1000 km in each direction for their winter overhaul, every year.

In BV all machines are owned by the districts that have the responsibility for economy, reliability as well as safety of the machines. In the first years many districts refused to send their machines to the now external workshops, since they where regarded expensive and not too service minded. The workshops had never before had any experience of competition. Sending machines in train formation with SJ was also seen as an unnecessary expense and the new trend was to make the machine overhaul within the districts, by own technicians and local workshops.

The result of this "boycott" was that the old competent workshops where losing their market and where forced to dismiss almost their whole staff. This meant that there was a drainage of competence from the traditional workshops. Some of them where closed down completely. The workshop that was specialised on tamping machines, track renewal trains and other more specialised machines was decided to be incorporated in a locomotive workshop in another town. One result of such a move is a risk of a considerable loss of competent staff and a messed up documentation, more difficult to use.

Forming and moving the new head office

Before 1988 all design, specification and purchasing of maintenance machines where made in co-operation between the maintenance machine experts and the Machine division of SJ. When BV was established, it was decided that the head office of BV should be moved from Stockholm to Borlänge, a small town more than 200 km from the capital of Sweden. Consequently the group that administrated the maintenance machines either moved to new jobs in the Stockholm area or retired. When the move to Borlänge was finished in 1992, the complete original staff for maintenance machines was exchanged and the Machine division, responsible of the commercial locomotives and wagons, was still a part of SJ, a different company.

In the new organisation it was also possible for the districts to buy machines without help from the head office, since the districts had the full responsibility.

The Railway Inspectorate

The Railway Inspectorate is responsible for the approval of all new regulations, all new vehicles and new traffic operators in Sweden. They also make inspections to verify that all regulations are fulfilled during the daily work.

New operators in the production

As BV was established there was a big increase of the production volume, regarding rail specific installations, due to the transportation policy decision.

This made it necessary to open the market for private contractors. The increase of volume was simply impossible to deal with using only BV´s own capacities.

Many foreign contractors have therefore been working in Sweden in the last years, together with new Swedish contractors.

NEED OF A NEW SET OF REGULATIONS

At almost the same time the administration of maintenance machines was transferred to more than twenty local owners, the central workshop competence was decreased and the head office administration was replaced with new people. It was also obvious that the old regulations where not relevant anymore. It was written for a centralised organisation that made its maintenance on schedule, in central competent workshops and with little respect to the cost.

The main task for the new central administration was therefore to create a new set of regulations that could make sure that at least three responsibilities of the machine ownership where fulfilled:

- traffic safety
- labour welfare
- environment protection

The concentration of the effort so far has been to make the sure vehicles are safe for traffic and that the ownership itself is carried out properly. So far there have been regulations and recommendations written in three parts of the structure of the new BV regulations:

- management regulations
- handling regulations
- technical regulations

Management regulations

Management regulations govern for example classification of machines, how they are bought, registered, marked and colour designed. They also regulates the need for inspections, necessary type approvals, how education is to be carried out, how reports should be made and how machines should be sold or disposed.

A new class of "working equipment"

A new class of maintenance machines was invented beside the conventional set of classifications, the class of "working equipment". This group covers everything that is not classified as rail mounted vehicles, from handhold equipment to big rail mounted machines as rail road excavators. The result is that no specific regulation, concerning driver competence or formal type approval, is necessary. This machine classification is very convenient for contractors that make shorter jobs for BV and for slow speed rail mounted machines that can be run with operators that are not certified as drivers. The disadvantage of the class is the prohibition to run outside closed working areas unless hauled by real rail mounted vehicles. All "approval" of working equipment is made by the local district.

Compulsory annual inspections

Apparently new central rules must not interfere with local autonomy regarding machines maintenance. As the centralised overhaul was not automatically replaced with local substitutes and the responsibility to keep machines safe is inevitable, the solution was an annual compulsory safety inspection. This inspection is carried out for every rail mounted machine classified as a vehicle. It is made in the same manner as the annual inspection of cars in Sweden. The result from this is that heavier maintenance is now made when necessary instead of on a schedule as in earlier annual big overhauls.

Module based driver education

The education of drivers of track mounted vehicles is now being changed from long courses for each model of vehicle, into a module based structure where earlier courses can be considered in a much greater extent. After a theoretical course in vehicle technology and traffic safety regulations, all model education's are based on "principle vehicle" educations. The idea is that a central well-structured education on a vehicle with similar technical equipment, is carried out before the actual model education is started locally. Education on new vehicle models can then be made locally, if the previous "principle vehicle" education is still valid.

Type approval of rail mounted vehicles

Approval of every new vehicle model is today based on a track permission from BV, that is then completed by a final approval from the Railway Inspectorate.

Since there where no general written regulation establishing a safety standard of rail mounted machines, the consequence has been demands for technical changes after machines where delivered. This has caused a lot of trouble and increased cost.

Handling regulations

The regulations about handling of maintenance vehicles are dealing with a new approach on how machines can be combined in transport, even if they are not of the "train type". They also govern how vehicles should be loaded and how machines that are not regarded as conventional rail vehicles can be transported. The main point is to allow all combinations of machines and vehicles that are equipped with compatible drawing gear, if their frames and transmissions allows the transport. After a combination is completed, a simplified brake calculation is made and the allowed maximum speed is decided.

Technical regulations

The technical regulations comprises as different subjects as labour welfare, technical installations concerning traffic safety and the protection of the environment.

Some examples of newly produced rules are technical regulations concerning:

- operator and driver cabs
- safety equipment such as driver vigilance devices, automatic train control systems and emergency stop systems
- brake performance
- safety of cranes
- classification of different types of drawing gear
- track circuit shunting

CONCLUSIONS

If the safety regulations of maintenance machines are detailed, adapted to present production needs and to a present administration, there is a risk of failing technical or administrative security systems if too much of the administration is changed in one step.

There seems to be a general lack of high level rules regulating what safety standard a maintenance machine should live up to. Before a decentralisation, like the Swedish, is carried out it is important to develop flexible rules. They should be flexible enough to withstand changing demands from the railway maintenance operations. Rules must therefore be based on function, with respect to safety, instead of on existing technology and present production needs. It is also a big advantage for the operations if these flexible rules are accompanied by detailed technical standards with descriptions of how brake systems, running gears et cetera can be carried out.

The positive part of the reorganisation of the Swedish rail maintenance in 1988 was that most of the new districts in a short time became very aware of the cost of their production. It was also more easy to make changes within the regulations, especially as new people where employed, without any railway experience but with knowledge of other industrial and transport activities.

On the negative side was the great loss of competence both inside the central administration and in the maintenance workshops. A considerable room for local mistakes was created, which has led to a machine fleet that is today quite diversified and with many unique machines with non standard sub systems.

International Rail Safety Conference

1997 LUCERNE

21 May - 23 May 1997
Swiss Transport Museum, Lucerne, Switzerland

Paper 9719

Tetsuro Aikawa

Cost-effective Measures against Signal Overrun Accidents

Publisher
2000 International Rail Safety Conference

Schweizerische Bundesbahnen
Chemin de fer fédéraux suisses
Ferrovie federali svizzere
Swiss Federal Railways

INTERNATIONAL RAILWAY SAFETY CONFERENCE (IRSC) 1997
21 to 23 May, Lucerne / Switzerland

PAPER:	**Equipment and Engineering** **Cost-effective Measures against Signal Overrun Accidents**
PRESENTED BY:	**Mr. Tetsuro Aikawa** **Vice Director**
DATE:	**22.05.97**
SESSION:	**VI**
TIME:	**1100-1130**

Cost -effective Measures against Signal Overrun Accident

- with consideration of human factors -

MAY 20 - 23, 1997

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1. Background of this Study

At the previous International Railway Safety Conference in South Africa, I presented a speech on "Global Risk Assessment in JR East", in which signal overrun accident was pointed out to be most risky event to our company. In these days, JR East has quite few fatal accidents, however, we do have some incidents which might lead serious accidents (Figure 1).

In our Safety Research Laboratory, we are trying to find effective measures to reduce such kind of events with reasonable cost. As one of the studies on this issue, we have evaluated how the number of such events has changed according to introduction and improvement of ATS (Automatic Train Stop system) in former Japanese National Railways (hereinafter JNR), as well as what kinds of problems left to be solved. This evaluation has suggested us how humans behave with new types of man-machine systems, and the way how to prevent accidents with reasonable cost-effectiveness.

2. Necessity of Backup System to Train Drivers

2.1 A Lesson from Mikawashima Accident in 1962

Thirty-five years ago, there happened a serious train accident in which 160 people were killed and 296 people were injured at Mikawashima station in Tokyo. This accident was a direct trigger for JNR to decide to install ATS in its railway system (Figure 2).

The accident consisted of three individual events. The first was a derailment of a freight train due to signal overrun. The second was a side collision between the derailed train and a passenger train. And the third was another crash between the former two trains and another passenger train.

The cause of this accident was that the engineer of the freight train did not stop at a stop signal probably because he believed that the signal was green.

2.2 Installation of ATS-S

After Mikawashima accident, JNR decided to install ATS on all of its lines in order to protect trains from accidents due to signal missing by train drivers. The ATS was called ATS-S for standard ATS (Figure 3).

ATS-S was a backup system with discontinuous control. When a train approaches a stop signal and passes a warning point (a ground coil), ATS-S issues an alarm with red lamp and buzzer sound to driver. If the driver does not apply brake and push confirmation button within five seconds, ATS-S applies emergency brake automatically.

Owing to the installation of ATS-S, JNR reduced its number of train accidents due to signal overruns by 50% in comparison with those in the previous five years (Figure 4).

2.3 Reasons for Simple System

An ideal backup system against signal overrun is to compare allowance speed and actual speed of train continuously to ensure any trains to stop at stop signals. At that time, however, JNR decided to install relatively simple system for the following two reasons.

Firstly, JNR had to complete the installation of ATS-S to all of its lines as soon as possible. In fact, they completed the installation on its 20,000 km lines in four years as they scheduled.

Secondly, the ATS-S had to be compatible with all the kinds of rail cars such as engines, electric multiple units, etc. in JNR with various types of brake system.

Such a situation made it difficult to develop a sophisticated system as a standard ATS.

2.4 Improvement of ATS Performance against Drivers' Stereotype Behaviors

Nevertheless, as the drivers became accustomed to existence of ATS-S, some new types of signal overruns began to occur in the weak points of the system.

For example, train driver who was overtaken and passed by the following faster train at station always saw stop signal when he drove into siding, and in every time he got an alarm from ATS-S. Since the drivers did not like to be bothered by such usual alarms, they sometimes turned off ATS-S, and as the result, some signal overrun accidents occurred without ATS-S activated. JNR should have taken a radical measure against such problems, but they just added another alarm system which was activated when driver drove train without ATS-S on.

3. Safety as a Cornerstone of Stable Management

3.1 A lesson from Higashi-Nakano Accident in 1988

In December of 1988, which was the second year of the privatized JR East, there was a train accident due to signal overrun again. In this accident, a train overran a stop signal and collided with the end of its leading train which had stopped at Higashi-nakano station. One passenger and one driver, both of them were on the following train, were killed (Figure 5). In this accident, although the exact cause of the signal overrun was not clearly identified, the ATS-S was working normally and it was imagined that the driver had reacted to its alarm unconsciously.

The accident reminded us of importance of safety as a cornerstone for stable management of a transportation company, and JR East decided to enhance its safety furthermore as the top priority of its management strategy.

3.2 Installation of ATS-P in Tokyo area

One of the activities in this strategy is introduction of ATS-P in Tokyo area.

In ATS-P, which is still discontinuous control system in exact meaning, information on distance to the next stop signal is transmitted to the on-vehicle-device which compares a speed check pattern and actual train speed continuously to ensure the train to stop at the stop signal. The P of ATS-P stands for pattern (Figure 6).

Significant progress of computer technology including development of high-performance micro-computer is one of the technological background of ATS-P.

3.3 Aimed Goals of ATS-P

The ATS-P has been developed aiming the following goals.

○ Highly safe system
On highly congested lines, since a small error may cause a serious accident, ATS-P is expected to secure trains thoroughly.

○ Human friendly system
ATS-P is expected to work only when it is needed. Service brake is still controlled by manual.

4. Cost-effective Backup System on Provincial Lines

4.1 Improvement of ATS-S

Another activity in safety enhancement strategy is an improvement of conventional ATS-S on provincial lines (Figure 7).

We have improved ATS-S so that, when a train is going to overrun home or departure signal, ATS applies emergency brake automatically without giving a five-second postponement to driver. We call it ATS-SN, for new standard ATS.

4.2 Aim of Improvement

The purpose of ATS-SN has been specialized to prevent train collision accidents at home and departure signals, where serious accidents tend to occur. At such signals, if needed, ATS-SN stops train immediately, and it can eliminate train collision accidents due to drivers' unconscious reactions to ATS alarms. ATS-SN is also expected to reduce crush impact even if collision accident occurs.

The performance of ATS-SN mentioned above has given a cost-effective safety improvement even though it may not be perfect.

4.3 Cost-effectiveness

Since ATS-P requires installation cost around 15 times as much as that of ATS-S, JR East has decided to install it on lines of around 700km in Tokyo area. We have completed 80% of the plan and the installation is still on the way.

In terms of ATS-SN, the cost for the improvement is only 10% of the conventional ATS-S, and by the year of 1992, JR East had completed the improvement on all of the rest lines of ATS-P.

Although ATS-P covers only 10% of JR East lines, since the priority has been given to congested lines, it covers 70% of passenger kilometers of JR East. It is a highly cost-effective safety investment (Figure 8).

5. A Study to conquer Weak Point of ATS-SN

5.1 A Lesson from Kaneko Incident in 1993

Nevertheless, again, there was a risky incident in April of 1993. At Kaneko station on a single track line with ATS-SN, a train which was supposed to stop at the station passed the station and its departure signal with considerable distance and managed to stop facing an oncoming freight train. The speed of the train at the home signal was 90 to 95 km/h while the speed limit was 45km/h. Although both of the driver and ATS-SN applied emergency brake, it was too late to stop by the departure signal (Figure 9).

Fortunately, nobody was killed or injured in this incident, however, ATS-SN was turned out not to be able to secure such a train with unexpected speeding. We have started a study to solve this problem in ATS-SN.

5.2 Evaluation of Past Accidents/Incidents Data

The aim of this study is to develop an inexpensive but highly safe system.

We have started with an evaluation of the data of past accidents/incidents, because we thought that such events reflected the tendency of human behavior and a careful evaluation of them would suggest a way to design a high safety-performance and cost-effective system we were seeking.

We have evaluated around data of 300 accidents/incidents due to signal overruns at home or departure signals in the past 30 years including some major accidents I have already mentioned. We had never done a study to evaluate such a considerable number of accidents and incidents systematically at a same time. It might be a kind of job which can be conducted only in a laboratory.

5.3 Results of the Evaluation

Figure 10 shows the result of the evaluation. In around 60% cases of the evaluated accidents/incidents, ATS-S actually secured trains from train collisions. In around another 30% of them, ATS-SN could have obviated possibilities of train collisions. And in the rest of them, the possibilities can not be obviated even by ATS-SN.

In most of the cases in the last category, ATS-P could have obviated the possibilities of train collisions, however, since the installation of ATS-P is limited in Tokyo area, we have to improve the performance of ATS-SN for non-ATS-P lines.

We have studied how train protection system should check train speed in order to prevent collision accidents which can not be covered by the present ATS-SN.

6. Possible Methods for Improvement of Train Speed Check

6.1 Increase of Speed Check Points in Discontinuous Control

Figure 11 shows one possible improvement of ATS-SN in which we expect to cover significant speeding by increasing speed check points.

As the result of our study in the light of the past accidents/incidents data, we have find the following problems.

○ Freight trains, whose braking performance is relatively poor, require some other check system.

○ In some accidents, train gained its speed after its passage of speed check point. For such cases, additional check points are needed.

Although, this method has a basic advantage of simplicity and low cost, if we intend to cover all types of potential causes of collision accidents, increase of speed check points is needed and the cost becomes higher.

6.2 Continuous Speed Check by using Location Information

Figure 12 shows an idea of continuous speed check by using location information. In this system, ATS compares speed check pattern and actual train speed continuously, and if the actual train speed exceeds the speed check pattern, ATS stops the train automatically. Since the speed check pattern is designed for emergency brake, whose braking force is stronger than that of service brake, as far as train is operated in normal, the automatic brake is never activated.

Since the system has speed check pattern on vehicle, it has some advantages compared with a simple discontinuous control. Firstly, the performance of the ATS is not affected by difference of brake performance of each train. Secondly, no train can gain its speed exceeding the speed check pattern even after it passes speed check point.

A disadvantage of this system is that, since this system is almost same as ATS-P, it is around twice as costly as the present ATS-SN.

7. Summary

7.1 Conclusions of the Study

The following are the conclusions of this study on signal overrun accidents and incidents.

○ An accident which has some possibilities to occur really occurs sooner or later. In the first step, just after Mikawashima accident 35 years ago, JNR established a backup system against stop signal missing. In the second step, after Higashi-nakano accident nine years ago, we began to improve the backup system so that it covers some unconscious behaviors of drivers. And now, we are required to cope with abnormal situations, such as station approach with unexpected speeding, etc..

○ Knowledge accumulation and technological progress make impossibility possible.

When JNR developed ATS-S for the first time, there was no micro-computer technology. Even in such a time, in Shinkansen system, they developed an extraordinary safe system with considerably high cost. And later, due to rapid progress of particular technology, it became possible to realize such a high-performance with relatively low-cost.

○ To reflect local conditions of transportation is a key to design highly cost-effective safety systems.

The reason why a low-cost continuous speed check system can be realized on provincial lines is that they have relatively simple line structures and low train frequencies. We were able to design a less sophisticated ATS for such lines, and as the result, the cost of the new ATS has been estimated only 15% of present ATS-P for Tokyo area.

7.2 Role of Safety Research Laboratory in Signal Overrun Prevention

Although our Safety Research Laboratory is a small organization with 60 people, we have experts from various fields such as operation, rolling stock, signal system, etc.. We even have experts of psychology. One of the advantages of our laboratory is that the experts from various fields can discuss a same issue in depth.

Another advantage of the laboratory is that, since we are not in line of daily jobs, we can concentrate our efforts on one thing. The study I presented here is one of the examples.

Although there are quite few laboratories specialized in railway safety in the world, we are seeking research partners to share our efforts, information, and results of studies on railway safety. We will welcome any people who come to Tokyo and discuss those issues in our laboratory.

Figure 1

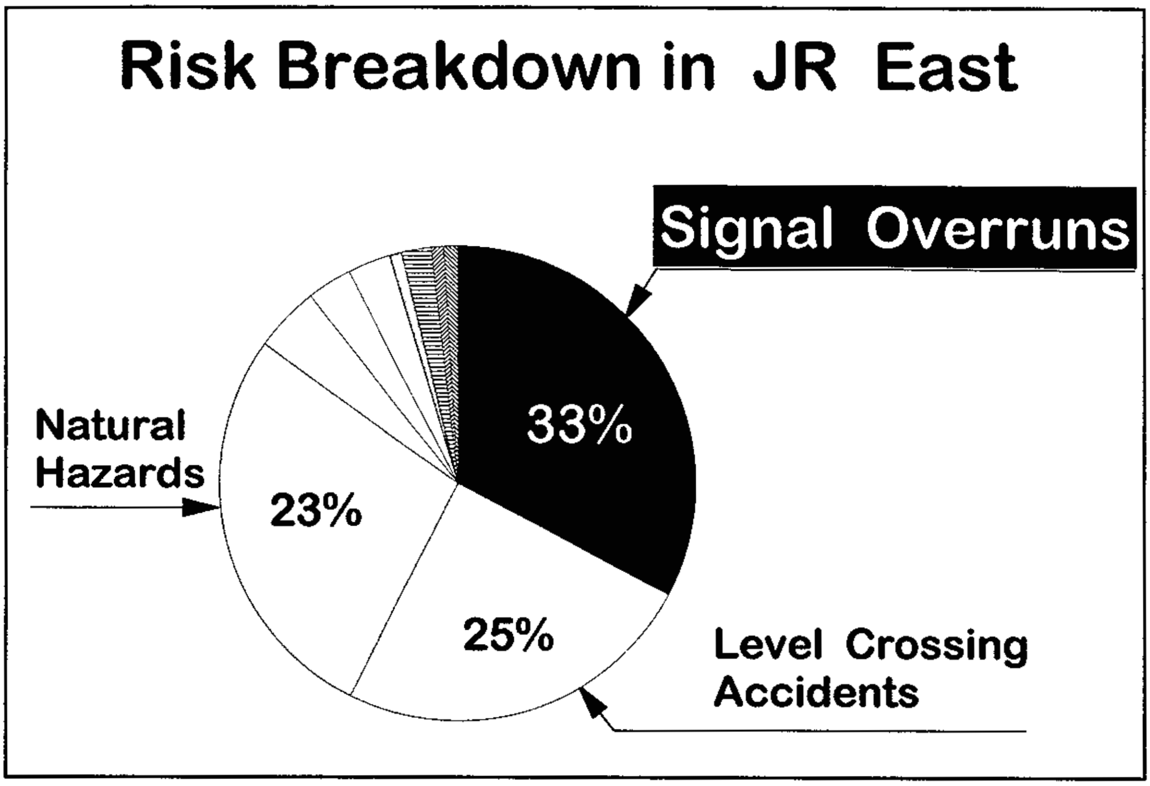


Figure 2

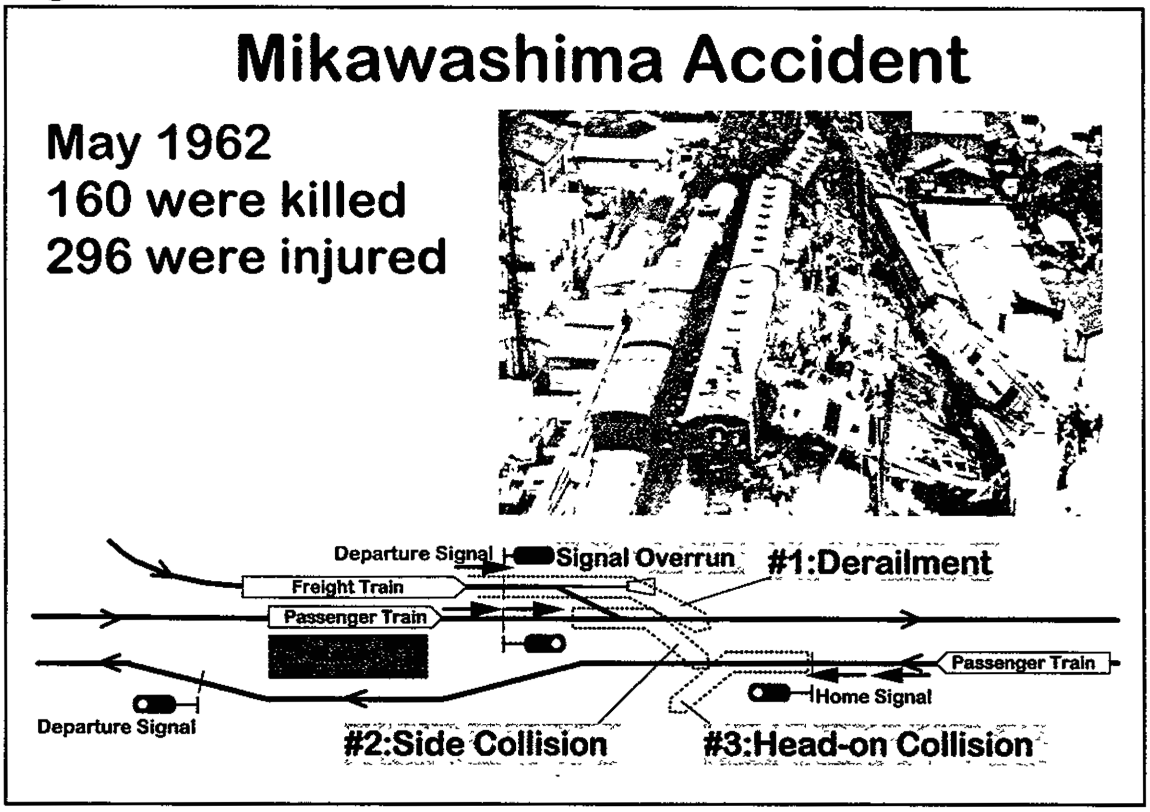


Figure 3

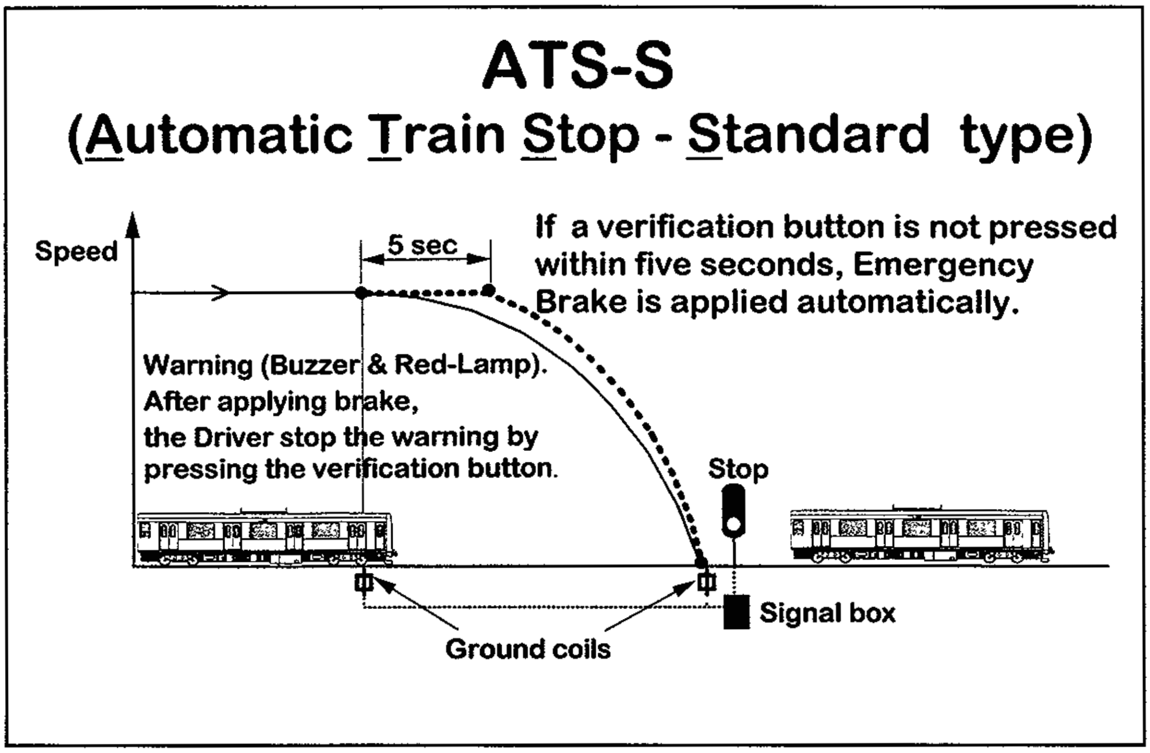


Figure 4

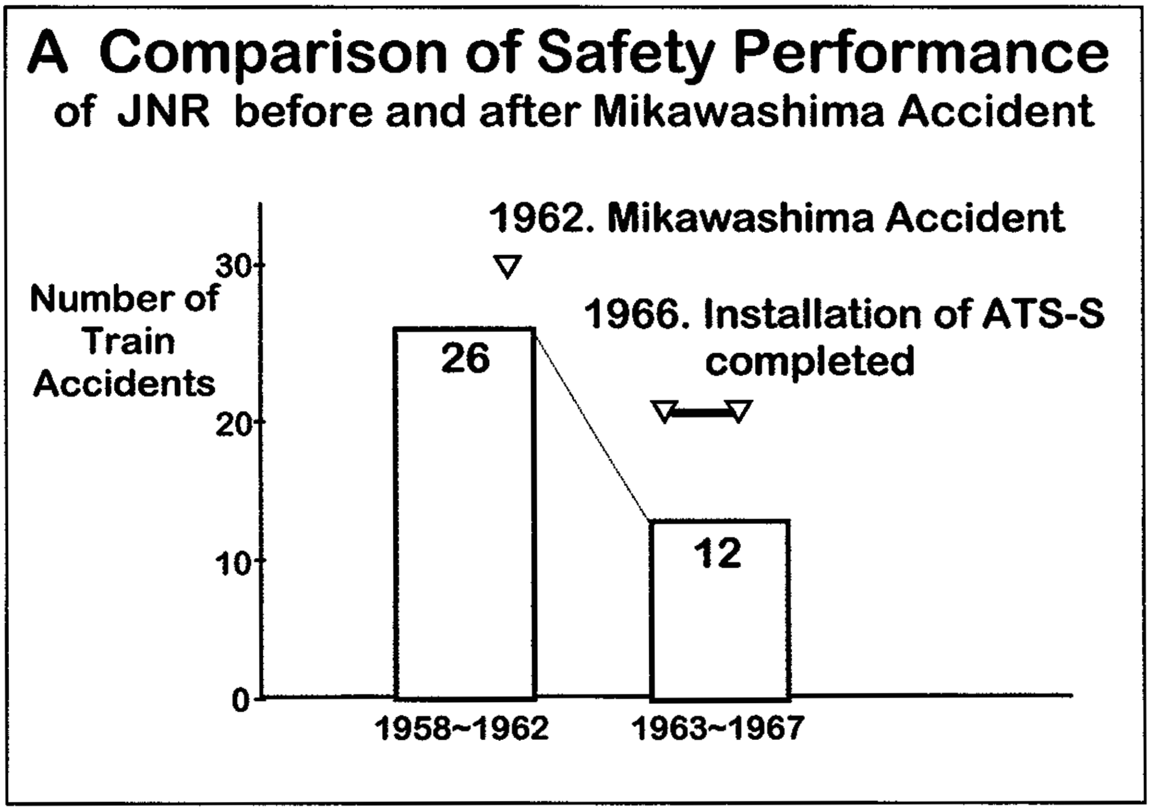


Figure 5

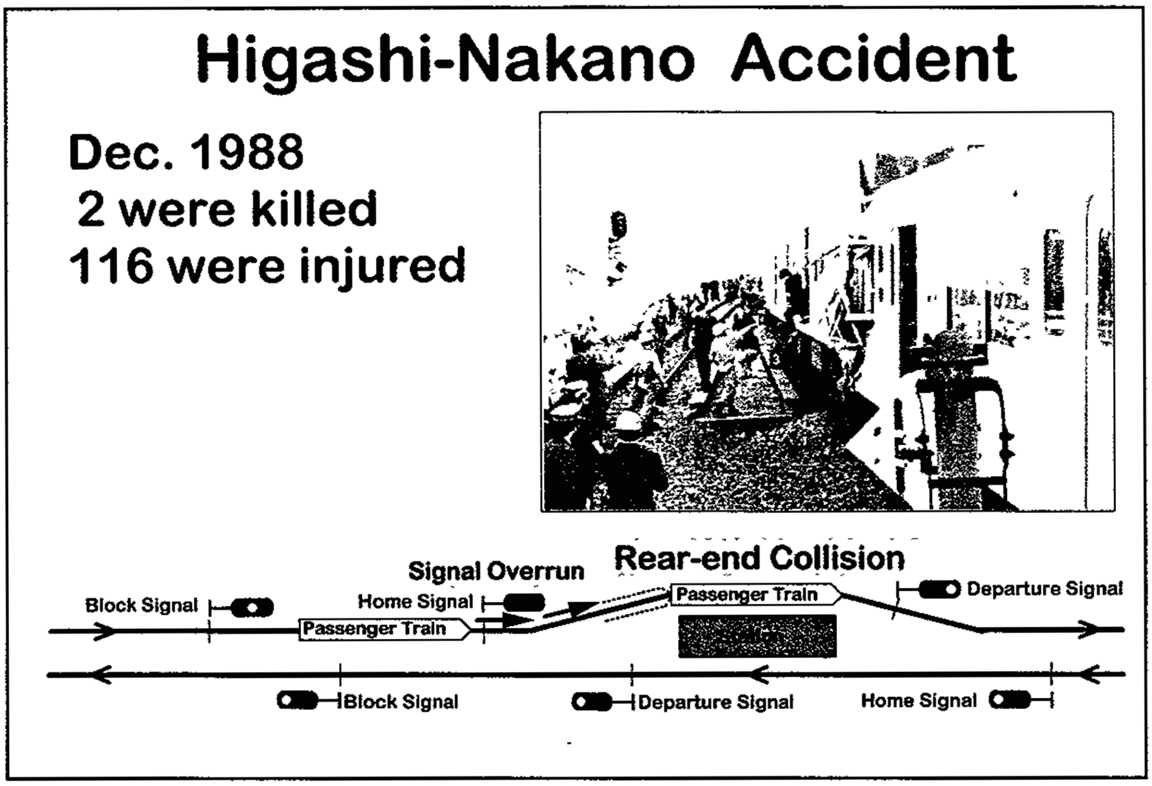


Figure 6

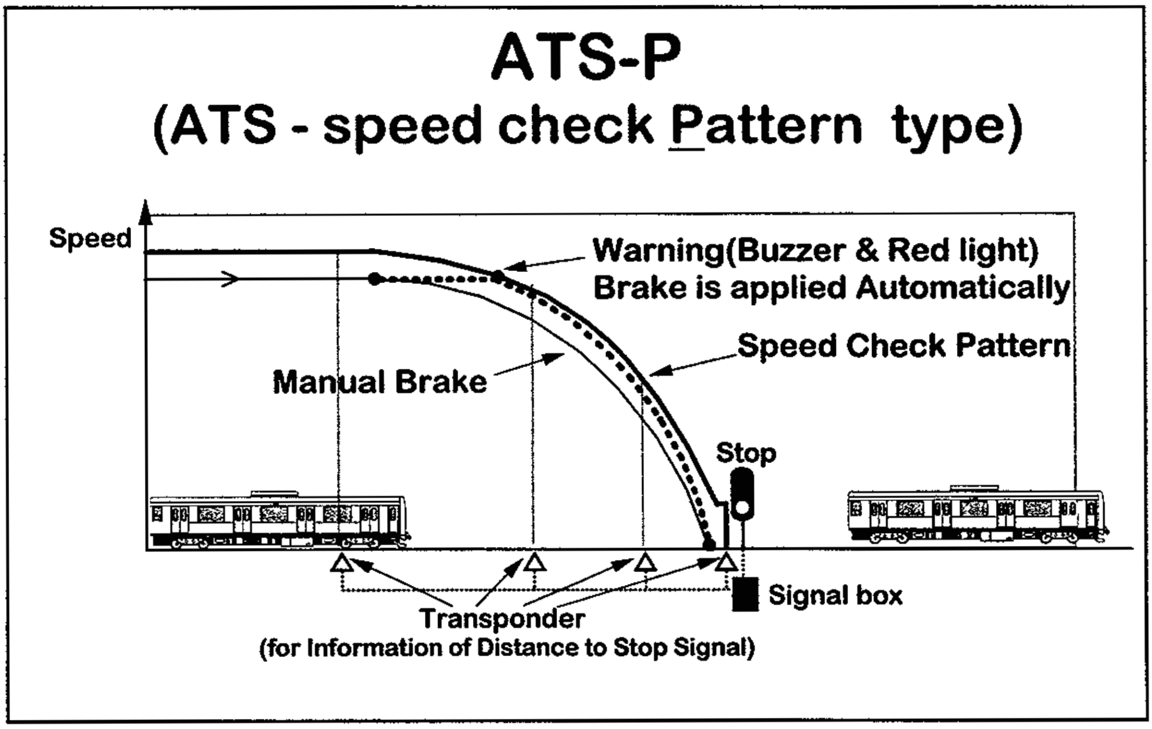


Figure 7

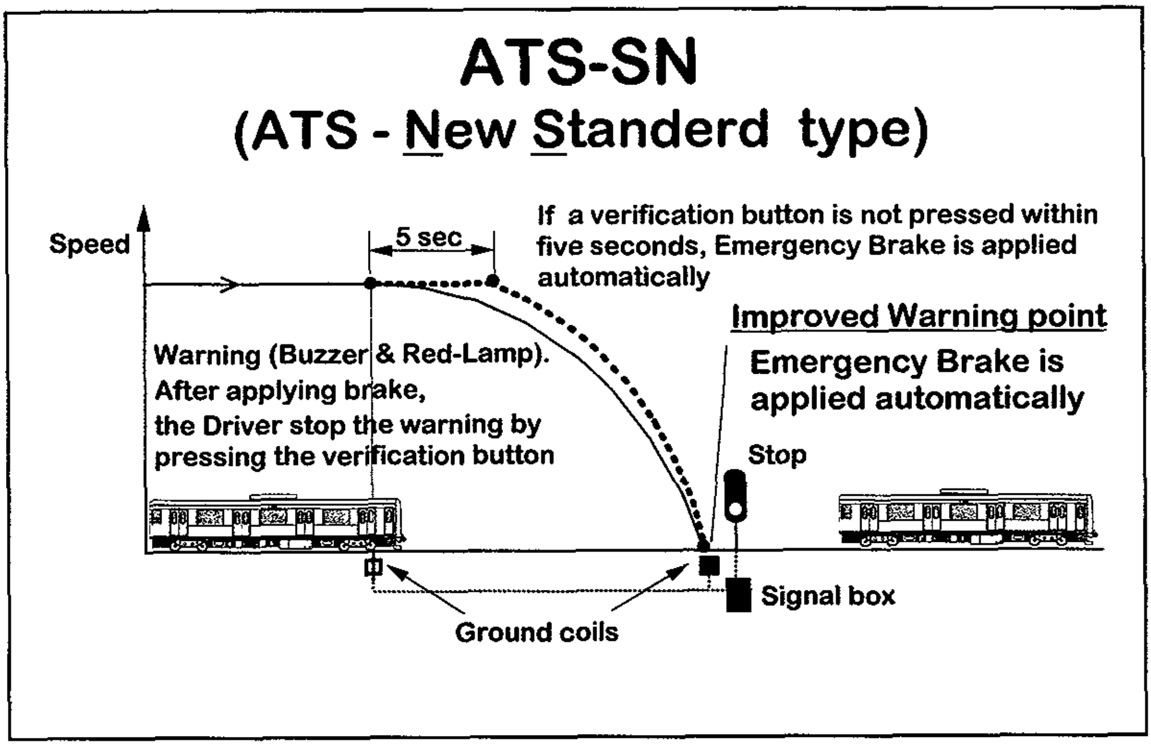
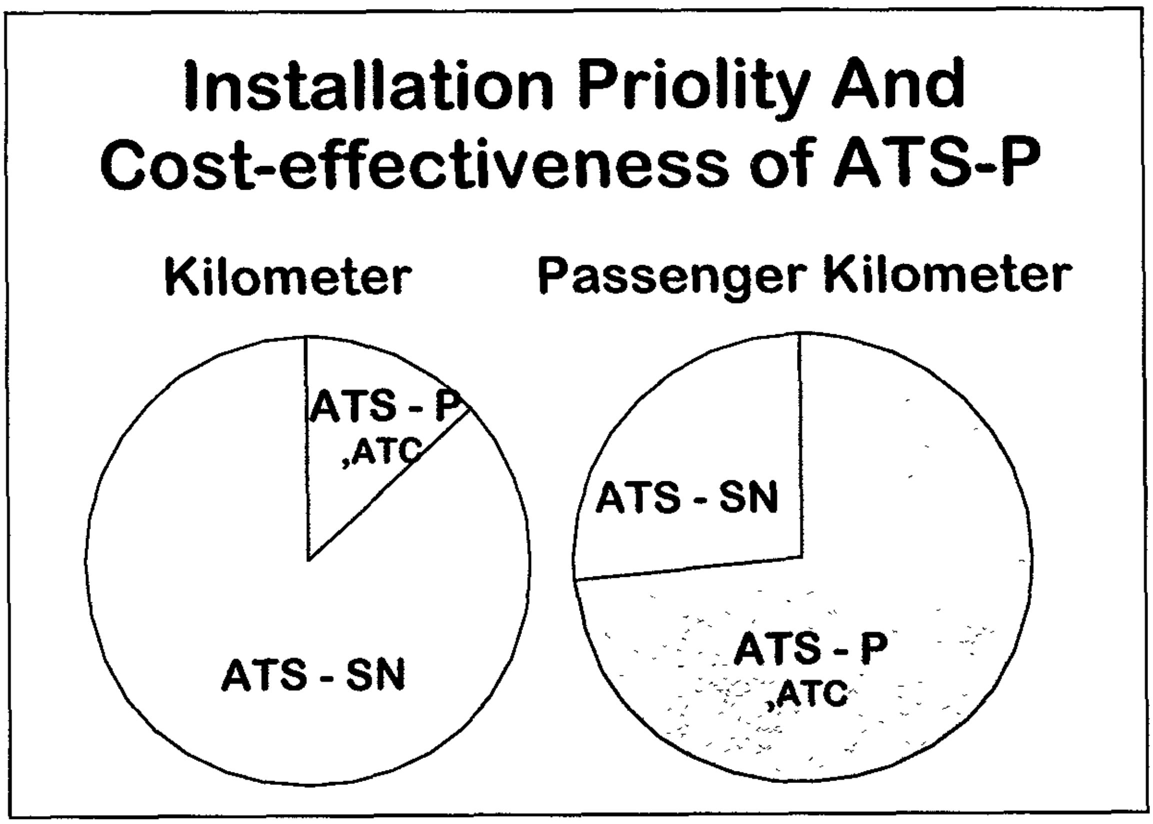


Figure 8



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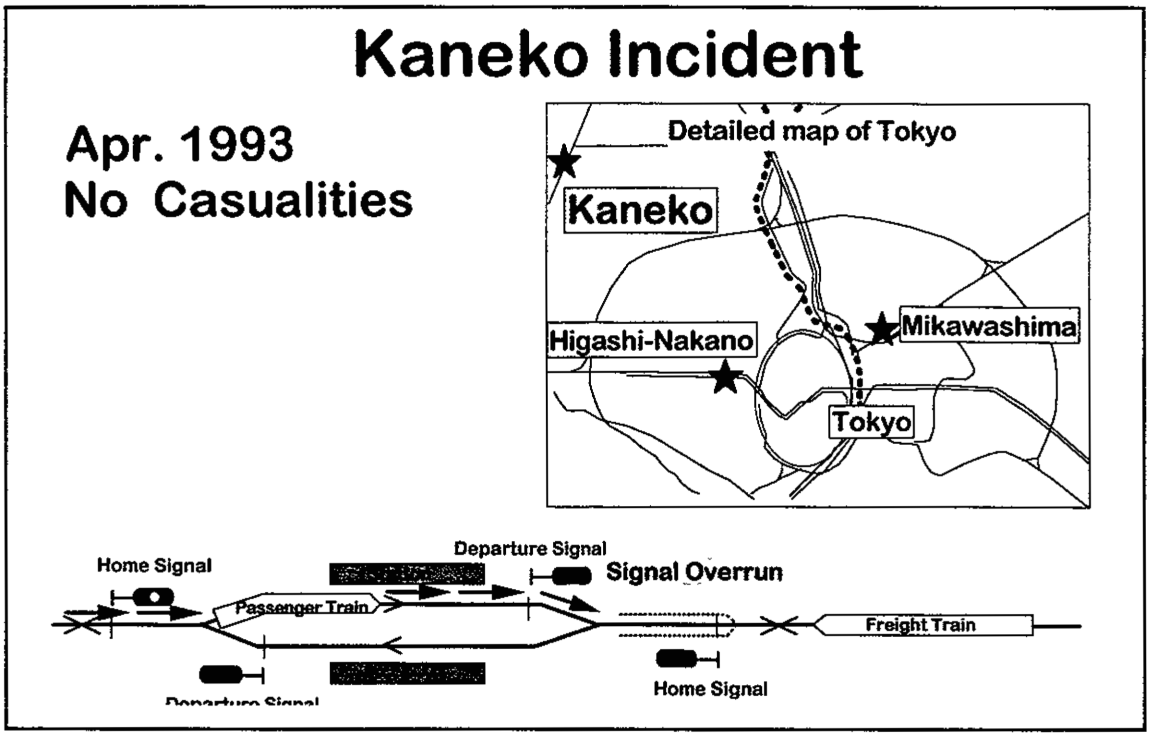


Figure 10

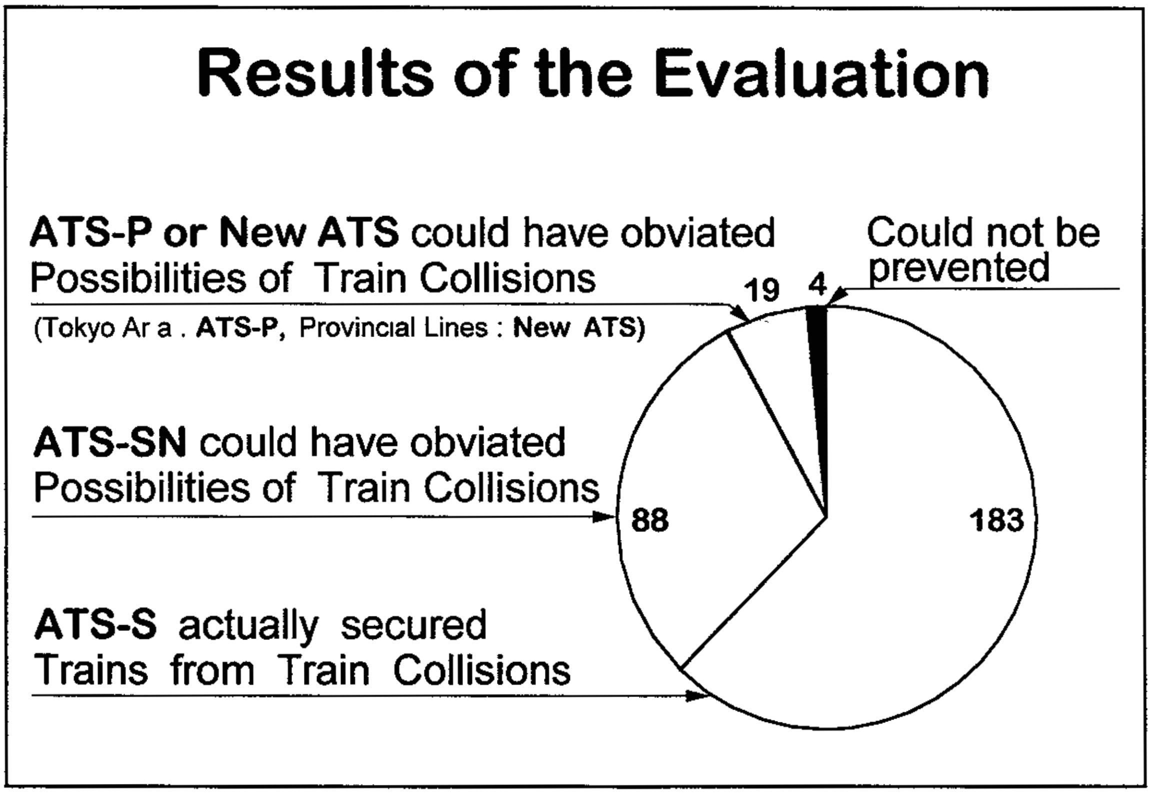


Figure 11

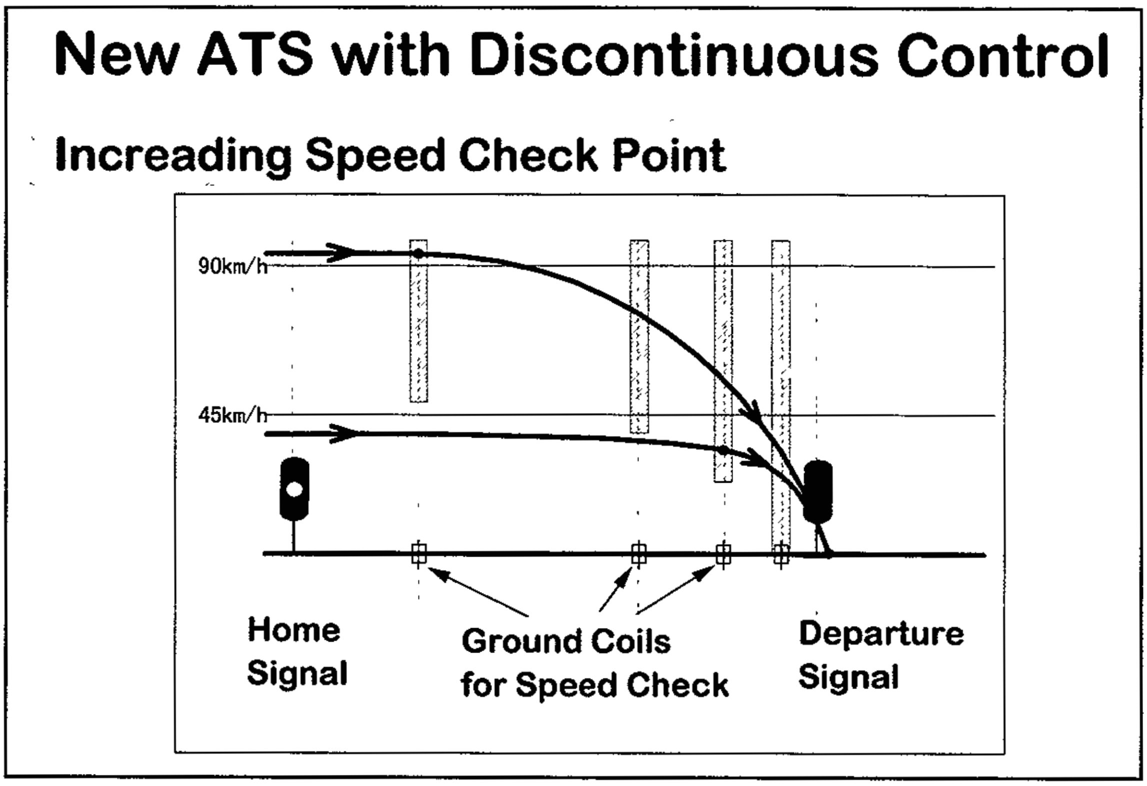


Figure 12

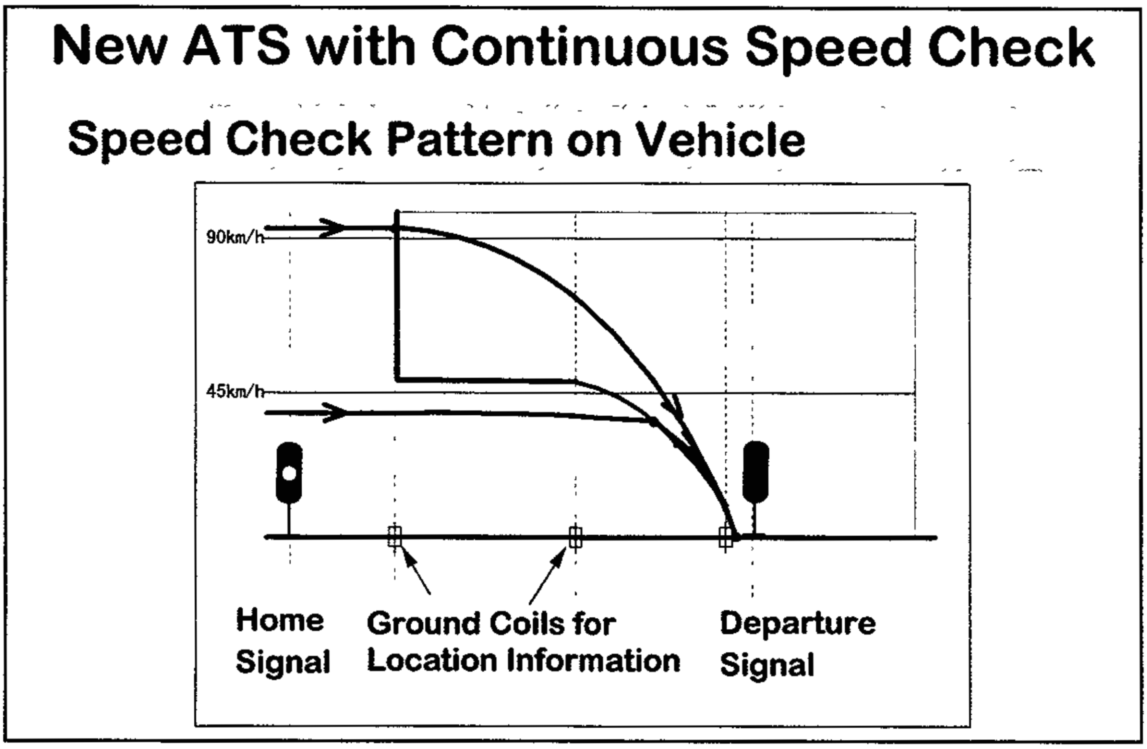
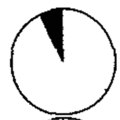
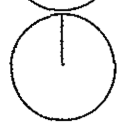
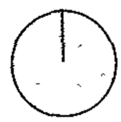


Figure 13

Measure

Direct Trigger	Type of ATS	Relative Cost	Security against Train Collisions
Mikawashima Accidents	ATS-S	1.0	
Higashi-Nakano Accidents	[Provincial Lines] ATS-SN	1.1	
	[Tokyo Area] ATS-P	15.0	
Kaneko Incident	[Provincial Lines] Speed Check Type New ATS	2.0	

International Rail Safety Conference

1997 LUCERNE

21 May - 23 May 1997
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Paper 9720

Don Davis

Tranz Rail's Alertness Management Programme

Publisher
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Chemin de fer fédéraux suisses
Ferrovie federali svizzere
Swiss Federal Railways

INTERNATIONAL RAILWAY SAFETY CONFERENCE (IRSC) 1997
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PAPER:	**Human Factor/Safety Management** **Tranz Rail's Alertness Management Programme**
PRESENTED BY:	**Mr. D Davis** **Corporate Manager Quality + Safety**
DATE:	**22.05.97**
SESSION:	**VI**
TIME:	**1130-1200**

CURRICULUM VITAE

Don Davis
Corporate Manager Quality & Safety
Tranz Rail Limited
New Zealand

- Don Davis from Tranz Rail Ltd, 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, but in the last seven years has been a team member of the recently formed Corporate Quality & Safety Unit. He is now the team leader of 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 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
- Investigation into the most serious rail occurrences
- Mainline derailments
- Crisis Management planning for the Company

International Railway Safety

Seminar May 1997

Tranz Rail's alertness management programme

DS Davis
Corporate Manager
Tranz Rail Ltd

Introduction

Sleep physiology studies show fatigue is inevitable for staff who work in a 24 hour operation

As such, fatigue is a major safety concern in the transportation industry

Although fatigue cannot be eliminated, it can be managed through a variety of approaches. Of these, this module is concerned with personal coping strategies.

The module is being presented to all Tranz Rail shift workers, managers and roster personnel. Its aims are to explain the physiology underlying fatigue and outline a range of countermeasures to minimise the chances of fatigue-related incidents or accidents.

What is fatigue?

Fatigue is really a catch-all term for a variety of different symptoms. It can be physical, such as sore back muscles after a day of gardening. It can also be mental, for example, difficulty concentrating, problems remembering information, slowed reaction times or nodding off. Furthermore, people are not very good at judging their own level of fatigue or how it is affecting them .

Why combating fatigue is important

Slide 1: Why address fatigue?

Fatigue makes staff more vulnerable to workplace accidents.

Fatigue slows down physical reaction time and mental processing, and affects memory. In short, fatigued people become more vulnerable to making mistakes at work.

Slide 2: The extent of the problem

75% of night workers experience sleepiness during shiftwork and 20% actually fall asleep on the job.

A rail industry problem?

A 1983 survey of Swedish loco engineers found 11% reported dozing off repeatedly while driving on night trips. Some 70% reported dozing off at least once on such trips

The survey indicated sleepiness remained low during the day, but became increasingly severe across the night trip.

The US National Transportation Board, which investigates public transport accidents, and the Federal Railroad Administration attributed 12 major rail accidents from 1986 to 1990 to engineers being asleep or impaired by sleep loss. Of these accidents, seven occurred between 4am and 6.15 am, and 11 occurred between 1am and 8am

A survey of seven Tranz Rail loco engineers in 1992 showed all had problems staying awake on night shift. This is not surprising. Findings from many studies indicate 75% of night workers experience sleepiness during shiftwork and 20% actually fall asleep on the job.

Understanding sleep

Sleep was traditionally viewed as the time when the brain and body shut down. It was thought reactivation occurred when sleep ceased. The reality is different. Sleep is a very complex process during which the brain and body alternate between extreme activity and quiet.

Slide 3: NREM/REM cycle

- ***NREM and REM sleep alternate throughout each sleep period***
- ***Most deep sleep occurs in the first half of the sleep period***
- ***In a normal night of sleep, REM periods are longer and more regular towards the morning.***

There are two distinct stages of sleep – NREM and REM. During NREM sleep physiological and mental activities slow. NREM sleep is divided into four stages with deeper sleep occurring during stages three and four, in which there is very little mental activity. If we awake directly from deep sleep, we feel very tired and groggy ('sleep inertia').

During REM sleep, the brain is extremely active and produces dreams.

In a normal night, the usual sleep cycle is 60 minutes of NREM sleep followed by 30 minutes of REM. However, most deep sleep occurs in the early part of the night Sleep during the day is different; both length and structure of the cycle changes when sleep occurs at unusual times.

The need for sleep

Like food and water, we need sleep to survive. There is a rare, inherited sleep disorder known as "fatal familial insomnia". People with this disorder become totally unable to sleep, usually between ages 30 to 60, and die within seven months to three years.

The most common disorder is sleep apnea. A person suffering from this disorder falls asleep but periodically stops breathing and wakes to breath again. The disorder can cause severe sleep disruption. Tranz Rail is asking staff who believe they have a sleep disorder to notify in-house medical people.

Sleepiness is a signal from the brain that you are not meeting a vital physiological need (similar to hunger or thirst). The only way to alleviate sleepiness is to sleep, whether you want to or not.

To be fully rested, people require a specific amount of sleep every 24 hours The average for adults is about eight hours.

The quality of sleep can be just as important as the quantity. Eight hours of disruptive sleep is only the equivalent of few hours of uninterrupted sleep.

If you don't get enough sleep for several nights in a row, then the effects build up like a bank account deficit. If the deficit is not made up during the week or on days off, it will be carried forward into the next week. Studies show two nights of unrestricted sleep are needed to ensure complete recovery from sleep loss.

Factors affecting sleepiness (Slide 4)

- Lack of sleep (including accumulated sleep debt)
- Age (as people grow older, their sleep at night becomes shorter, lighter and more fragmented)
- Medical conditions
- Alcohol
- Environmental factors (eg. sudden noises, light, temperature)
- Daily cycle of circadian biological rhythms (see next section)

Note: Alcohol has a profound effect on the sleep cycle and can eliminate all REM sleep in the first half of a sleep period. This can lead to alcohol withdrawal effects in the second half, including sweats and sleep fragmentation.

Circadian rhythms

Slide 5: Circadian rhythms

- ***A circadian clock in the brain coordinates daily cycles***
- ***The clock programmes us to sleep at night and perform activity during the day***
- ***Without any time clues from the environment, the biological day is about 25 hours.***

Human beings are regulated by daily cycles which control body temperature, hormone production, digestion, and other bodily functions. At certain parts of the day, for example, your body will produce more or less of a particular hormone.

The circadian biological clock, as it is called, essentially synchronises all the different parts of the body to harmonise with a particular cycle. In a nutshell, it programmes the body to be asleep at night and awake during the day.

Without any time cues from the environment, the biological day is actually about 25 hours.

The ability to perform physical and mental work fluctuates with the cycle of the clock. For example, cortisol, a hormone involved with metabolism and stress responses, reaches its highest levels very early in the morning and drops to very low levels by the end of the day. As such, the ability to perform physical tasks is normally greater in the morning.

Slide 6: Times of vulnerability

- **3am to 5am**

- lowest body temperature
- maximum sleepiness
- worst physical and mental performance

- **3pm to 5pm**

- secondary peak in sleepiness
- performance drop in some tasks

- ***Half of Tranz Rail's sleep-related incidents (1990 to 1995) happened between 4am to 5am.***

People are most vulnerable to making errors when their body temperature cycle drops to its minimum level at night. Given that shiftworkers stay awake throughout the night, it would be logical to expect their performance to get worse as sleep loss mounts. However, as body temperature begins to rise again in the morning, performance improves even without sleep. Anyone who has tried to stay awake all night knows that there is an early morning slump and then things get easier.

People don't all have the same circadian rhythms, which means they don't function at the same level at similar times of the day. However, studies show accidents are most likely to occur between 3am to 5am and 3pm to 5pm. Some researchers argue the window of vulnerability in the early morning is wider and more like midnight to 8am. Three quarters of Tranz Rail's sleep-related rail incidents from 1990 to 1995 occurred between these times. Half of these incidents occurred between 3am and 5am. More than 90 percent of the sleep-related major incidents in the United States from 1986 to 1990 occurred between midnight and 8am.

A number of major industrial disasters involving human error have also occurred on night shift. These include the nuclear accidents at Three Mile Island in the United States and Chernobyl in Russia.

Clash between shiftwork and circadian rhythms

Slide 7: Shiftwork and circadian rhythm clashes

- ***Shiftwork means overriding circadian clock programming to sleep at night and undertake activity during the day***
- ***Clock gets conflicting messages from the environment***
- ***People tend to switch back to their old routines on days off.***

Shiftwork results in people working in a way that is out of synch with their circadian rhythms, which gear the body to sleep at night and work during the day.

Fatigue is often increased by the fact the circadian clock is very resistant to changing to a new schedule. This means shiftworkers are forced to try and sleep when their biological clocks are set for activity (wake maintenance zones).

Resistance to adapting to a new schedule can be intensified by receiving mixed messages from the environment as to what really is the time of day. In addition, a lot of shiftwork is based on a rotating roster, and most shiftworkers prefer to go back to being active during the day and sleeping at night during their time off work. As a result, shiftworkers' body clocks seldom get the chance to adjust to one schedule.

Common fatigue misconceptions

Slide 8: Common misconceptions

- ***An eight hour rest period allows enough time for sleep***
- ***I can handle sleep deprivation***
- ***There is a quick fix***

An eight hour rest period allows enough time for sleep

This idea doesn't take into account the time it takes to get home and prepare for bed. Time may also be needed to relax and unwind. Also, the notion doesn't recognise that people cannot sleep equally well at certain times of the day.

I can handle sleep deprivation

Motivation, training and attitude can help fight off sleep for a limited time, but sleep will eventually win. In addition, the ability to cope with disturbed sleep decreases as a person gets older.

There is a quick fix

There is no one easy solution to all the problems of fatigue, sleep loss, and disturbed circadian rhythms. People react differently to the demands of different jobs. Be sceptical when you hear claims of a simple remedy that will work for everybody.

Alertness management strategies

Slide 9: Alertness management strategies

Preventative

- ***Getting enough sleep***
- ***Naps***
- ***Good sleep habits***
- ***The right environment and lifestyle***

Operational

- ***Cab exercises***
- ***The vigilance device***
- ***Strategic use of caffeine***
- ***Cab napping***

The following strategies are only recommendations. You will need to experiment to find what is best suited to you and your work. No one strategy will work for everyone in every situation.

Preventive and operational strategies

Preventive strategies are things you can do away from work to improve your sleep and help your circadian clock adapt to a shift roster. Their aim is to minimise the disruption caused by shiftwork and help you to arrive at work in the best possible condition, thereby also increasing your overall quality of life.

Operational strategies are intended to help you get through times of difficulty in maintaining alertness and performance on the job. They help you work safely at critical times.

Strategies

1. Getting enough sleep

Aim to be at work as well-rested as possible before going back to work, remembering the effects of sleep loss accumulate over time.

When working shifts, you may have trouble getting the required sleep in one hit. You may need to sleep in the morning and then again before you go back to work in the evening. Naps can be very beneficial in these situations.

You cannot force yourself to fall asleep. If you can't sleep, try reading or something relaxing. Lying awake worrying about being unable to sleep can be counterproductive, and may have the effect of conditioning yourself to associate going to bed with staying awake.

2. Naps

Scientific evidence indicates naps improve alertness and performance. If you are napping just before work, you want to minimise deep sleep, which can leave you feeling groggy and disoriented for up to 15 minutes after waking up. To avoid 'sleep inertia', limit the duration of the nap to 45 minutes or less.

When there's time, a nap can be longer. Two hours should get you through a complete sleep cycle and you won't feel groggy.

Even a very short nap can have significant benefits. It is better to get some sleep than none at all.

3. Good sleep habits

Slide 10: Good sleep habits

- ***A presleep routine***
- ***Keep sleep time sacred***
- ***Do not eat or drink heavily before bedtime***
- ***Physical and mental relaxation techniques***
- ***Stop trying after 30 minutes***

A presleep routine

In the bedroom, avoid thinking about activities that do not promote relaxation and sleep.

Keep sleep time sacred

At home, try to protect your sleep time and minimise responsibilities that could interfere.

Do not eat or drink heavily before bedtime

Going to bed hungry, or with a very full stomach, can make it harder to fall asleep. Avoid alcohol just before bed. It may help you to relax and fall asleep, but it disturbs the quality of your sleep. Caffeine and nicotine stimulate your nervous system, making it harder to fall asleep and disrupting sleep quality.

Physical and mental relaxation techniques

There are a variety of techniques to help people fall asleep faster, for example, meditation, positive visualisation, deep breathing, yoga. These are skills that have to be learned and practised before feeling the benefits.

Stop trying after 30 minutes

As already discussed, there is no point lying in bed getting frustrated because you cannot sleep. Get up and do something to help yourself relax.

4. The right environment and lifestyle

Slide 11: The right environment and lifestyle

- ***Set up an environment conducive to sleep***
- ***Strenuous exercise not recommended***
- ***Follow a balanced diet***

Physical aspects of the environment can disturb or aid sleep. It's easier to sleep in a darkened room. Sudden sounds can be disruptive Sleep is more restful if the room is cooler rather than hotter.

Strenuous exercise shortly before bed is not recommended. Some experts recommend that you should not exercise strenuously less than six hours before going to bed.

A balanced diet will help your overall health, including your sleep. Call in sick if you believe yourself unfit for work and unable to operate safely.

5. In the cab (Slide 12)

- Look for ways to increase stimulation, such as physical activity Even stretching will help.
- Talk to the train controller (airline industry studies show conversation in the cockpit helps deter sleep).
- Turning on the radio, or blasting cold air into your face can help (Tranz Rail is looking at equipping locomotive cabs with radio-cassette players).

6. The vigilance device

A 1991 joint company/union working party recommended the vigilance alarm system be enhanced and combined with an improved event recorder. It was considered the current vigilance system was good at waking loco engineers, but not good at keeping them awake As such, a new "Kaitiaki" integrated vigilance/logging system has been developed and is currently being assessed.

Four forms of the vigilance device are to be assessed, ranging from a fixed time light cycle to random and speed dependent settings. Another option is to install a feature to prevent repetitive cancellation. As part of the final assessment, loco drivers who test the formats will be asked to complete a questionnaire and provide comment.

Train Control can now monitor penalty brake and emergency applications. In the event of a problem, TCO will automatically be alerted and, after contacting the driver, will take appropriate action.

7. *Strategic use of caffeine* (Slide 13)

- Avoid using caffeine when you are already alert, such as at the beginning of a duty period or after a nap. Save it for the hard times, like the 3am to 5am dip.
- Caffeine usually takes about 15 to 45 minutes to have an effect and lasts for three to five hours.
- Caffeine affects people differently. To prevent sleep interference, you may need to stop taking caffeine well in advance of bedtime.
- Caffeine is a diuretic. Drink other fluids to stay hydrated.

8. *Napping in the cab*

Napping is a very effective strategy if the opportunity arises while waiting in a crossing loop or depot. You must, however, let the train controller know what you are doing, and ask for a wake up call after a maximum of 40 minutes. This time limit reduces your chances of going into a deep sleep and experiencing sleep inertia problems.

(Slide 14) Note: If you are fighting a losing battle with sleep, stop the train and go for a walk. But, make sure the train controller knows what you are doing.

Conclusion (Slide 15)

- Fatigue can have severe consequences – take it seriously.
- Take steps to improve your ability to cope with fatigue.
- Tailor the information from this presentation to meet your own needs.

There are no simple answers, find out what works for you.

International Rail Safety Conference

1997 LUCERNE

21 May - 23 May 1997
Swiss Transport Museum, Lucerne, Switzerland

Paper 9721

Jan Stuifmeel

Safety Philosophy New Freight Line

Publisher
2000 International Rail Safety Conference

Schweizerische Bundesbahnen
Chemin de fer fédéraux suisses
Ferrovie federali svizzere
Swiss Federal Railways

INTERNATIONAL RAILWAY SAFETY CONFERENCE (IRSC) 1997
21 to 23 May, Lucerne / Switzerland

PAPER: Case Study
Safety Philosophy New Freight Line

PRESENTED BY: Mr. Jan Stuifmeel

DATE: 22.05.97

SESSION: VI

TIME: 1200-1230

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Safety philosophy
Case study
new freight line

Colophon

Author	J. Stuifmeel
Reference	RnV/97/U13.001/011
Version	1.1
Date	16 April 1997
File	U13_001.011
Approved	Yes

Contents

1 Introduction/approach

This safety philosophy represents the basis for the overall safety recommendation:
"Freight line and safety effects".

Even during the design phase of the freight line, numerous decisions are taken which will determine the final safety result. Many safety measures are implicit in the design of the infrastructure and other components of the rail traffic system. In order to arrive at balanced (design) decisions/measures, a framework is necessary, known as the safety philosophy.

1.1 Background

The background for developing a safety philosophy for the freight line is the fact that the Project Management Team considers that an overall safety recommendation is necessary, in respect of a project of this scale. The Project Group has in advance requested a clear explanation of the eventual safety levels, for all parties involved. In this light, the recommendation relates not only to the infrastructure, but also to the rolling stock, the safety systems, the management systems and the communications systems, the (future) process operations, external influences, etc.

1.2 Objective

The objective of the safety philosophy is to provide an acceptable framework of safety levels for all parties involved. The philosophy also indicates the way in which the levels of safety should be assessed.
In respect of railway safety, a "uniform guideline" will be laid down, for all parties involved, in the form of:

- definitions/terms and overall thinking;
- limiting conditions imposed by the environment and design frameworks;
- objectives to be achieved.

1.3 Target group

In the first instance, the safety philosophy is intended for the project management responsible for the design and implementation of the complete rail infrastructure, in relation to the design standards and functional safety specifications to be upheld.
At a later stage, the document will be used as an assessment framework for imposing safety specifications on rolling stock, management and safety systems, the planning of the transport process, and the management of train services.

2 Approach/phases

The approach for the entire "Freight line and safety effects" project is focussed on providing answers to the following questions:

- Which (feasible and accepted) requirements will be placed on the level of safety on the freight line?
- How will this level of safety be determined?
- What action will have to be taken if the level of safety proves insufficient, or excessively stringent?
- What decisions and measures will have to be taken, in order to achieve the predetermined levels of safety? Considerations within the freight line's subsystems (infrastructure, stock, staff, transport process, maintenance, etc.).
- How can decisions be translated into actual safety requirements?

3 Points of departure, limiting conditions and criteria

3.1 Points of departure and limiting conditions

The points of departure and limiting conditions listed below relate to the safety philosophy:

1. The safety philosophy covers the entire transport system, therefore also including infrastructure, safety, management of train traffic, stock, staff, process operation, and contingency planning.
2. National and international legislation and implementation orders.
3. The routing decision.
4. Current planning.

3.2 Criteria

The safety philosophy must comply with the following criteria:

1. It must match individual and social perceptions. In this connection, of particular importance is the yardstick according to which the target and achieved levels of safety are presented.
2. It must have social and political support. The degree of "risk" (unsafety) must be accepted by society.
3. It must be financially and economically feasible. In other words, the requirements to be imposed must be achievable, within the available project budget and the annually available operating budgets.
4. It must match the practical operation of the design.
5. It must be clear and explainable.
6. It must be unequivocal and repeatable.
7. It must be achievable and usable.

4 Safety philosophy

4.1 Definitions

Railway safety:
The degree of absence of risk in and as a result of the rail transport system. Risk relates to injury and damage.

Rail transport system:
The complete combination of staff, resources and methods making a direct contribution to rail traffic within a railway network or part thereof.

Injury:
Human contact with a source of energy or a substance above the physical threshold value, leading to death, physical injury and incapacity to work, absenteeism from work, occupational illness or mental problems, for the at-risk groups listed below:

- neighbours
- passers-by
- railway workers
- road users
- vandals, saboteurs
- passengers
- train crew
- emergency services
- potential suicides

Damage:
Contact with a source of energy or substance above the threshold value for the body or object, resulting in fire, explosion, material loss, liability claims, product loss, environmental damage, negative press reporting, production stagnation, loss of licence or loss of goodwill.

Neighbours:
Neighbours are those persons present in homes, factories, offices, schools, etc.

Passers-by:
Persons on or around the rail infrastructure, such as children playing, walkers and train spotters.

Railway workers:
Railway workers are those persons tasked with work close to or on the rail infrastructure.

Road users:
Persons using roads located close to the rail infrastructure.

Vandals/saboteurs:
Persons guilty of destruction / persons deliberately endangering or interrupting train traffic by means of damage, destruction, or some other means.

Potential suicides:
Persons with a tendency / intention to commit suicide.

Passengers:
Persons intending to travel with the train, and thus found in or close to a train, or using the infrastructure with a so-called transfer function (platforms, platform crossings, escalators, etc.).

Train crew:
Persons carrying out their profession in or close to trains, such as drivers, travelling ticket inspectors, carriage and wagon examiners, shunting staff, etc.

Emergency services:
Persons professionally on or close to the rail infrastructure, for the provision of assistance, such as (railways) police, fire service, municipal health authorities, re-railing teams, duty staff, emergency workers assisting at incidents involving hazardous substances, etc.

4.2 Safety standards

Despite the fact that the new freight line is specifically intended for the transport of freight, indicative "standards" have nonetheless been included in the list below, for all at-risk parties. With the exception of the risk standard for the Transport of Hazardous Substances [2], there are no transport standards which are generally recognised in the Netherlands. Such standards and their implementation are, however, being developed, for example for the High Speed Train line South and the High Speed Train connection East [3, 4].

In the "Memorandum on Risk standards for the Transport of Hazardous Substances", it is stated that there is an assumed risk, in susceptible locations, such as residential areas, shopping centres, recreation grounds and office buildings, that fatalities will occur due to the release of hazardous substances in the event of an accident. It is however notable that the risk of such accidents is relatively small, and that the users of the susceptible locations are unable to exercise any influence on the degree of risk.
The "inability to exercise influence" plays an important role in this connection.

From the above defined at-risk groups, neighbours, passers-by and road users are unable to exercise any influence on accidents. By way of a working hypothesis, a common "standard" will be employed for all of these groups, on the understanding that the risks in question not only relate to the release of hazardous substances, but also to incidents in general. It should therefore be noted that the same calculation method should be employed.

In respect of passengers and rail staff, for the working hypothesis, the same principles are applied as in the Strategic Policy Plan on Railway Safety [5].
The target value for passengers in 2010 is a risk of 0.15 (design *hypothesis) for fatal* injury, per billion passenger kilometres.

For rail staff, the target value in 2010 is a risk of 0.25 (design hypothesis) for fatal injury per year, per *10,000 employees.*

The target safety levels are summarised in table 1.

At-risk group	standard/working hypothesis[1]	dimension
· neighbours · passers-by · road users	individual risk (threshold value): 10^{-6} orientation value for group risk: 10^{-4} for 10 victims; *10^{-6} for 100 victims, etc.*	see [2]: Risk standards, Transport of Hazardous Substances
staff · infrastructure employees · shunters · drivers · travelling ticket inspectors	 design standard: *0.25* design standard: *0.25* design standard: *0.25* design standard: *0.25*	risk of fatal injury per employee per year per 10,000 employees per job category
passengers	design standard: *0.15*	risk of fatal injury per year per 10^9 passenger kilometres

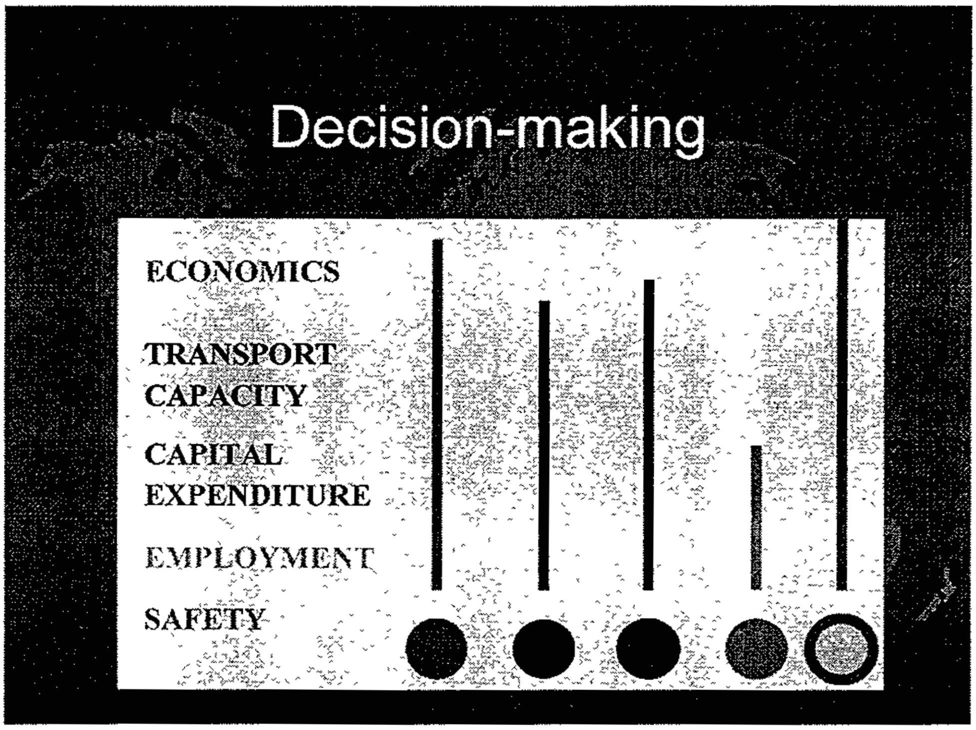
[1] In italics: working hypothesis

5 Method

A method is necessary for the implementation of safety and cost management within the project. The method must comply with the following conditions:

- the possibility of quantitative assessment of the safety of all interested parties;
- the possibility of breaking down the safety contribution into manageable components of the system;
- a match with design practice, in order within that practice to implement safety contributions and cost management, and
- a clear presentation of interrelations, at interface level.

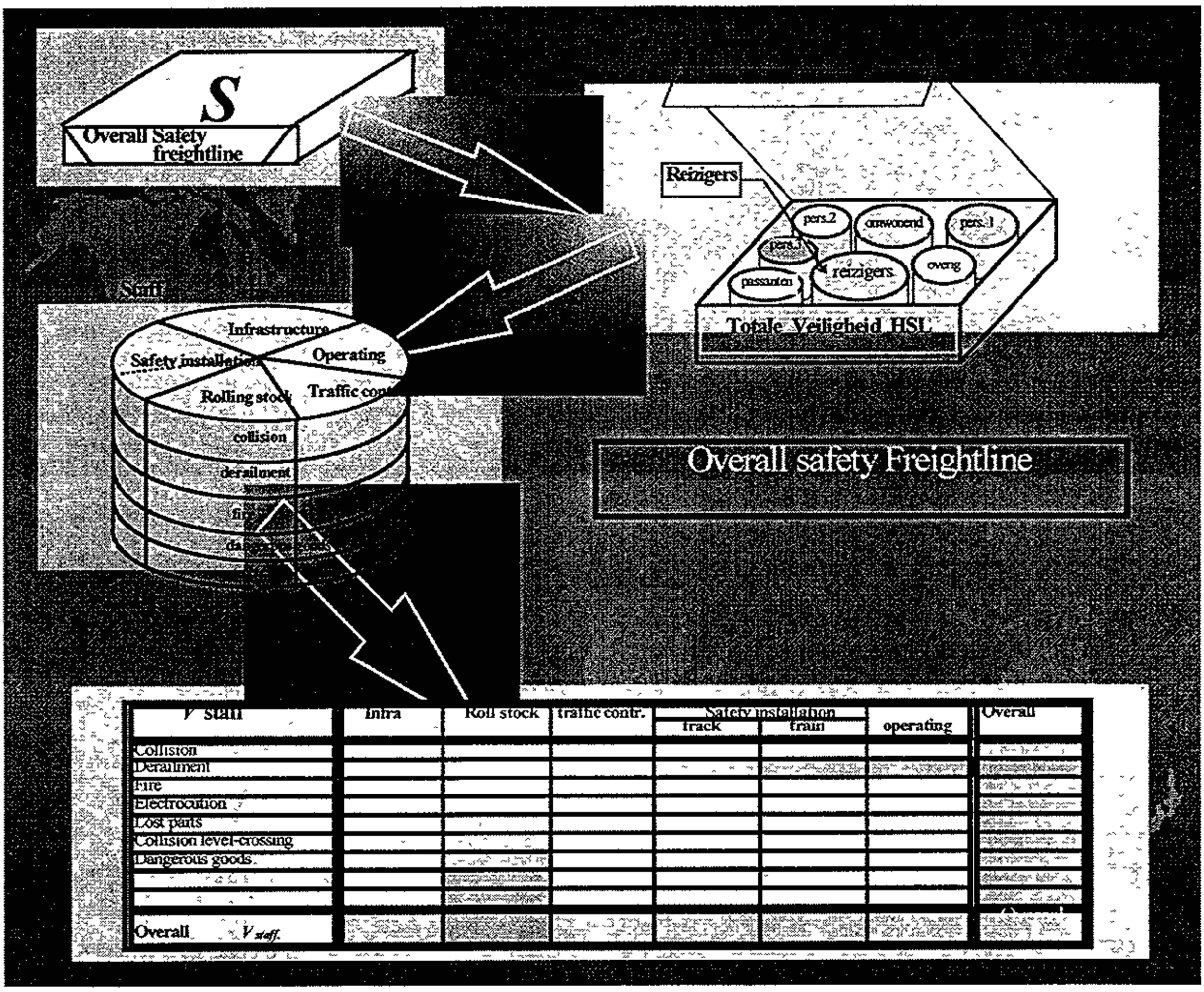
Safety is one of the items in the decision-making.



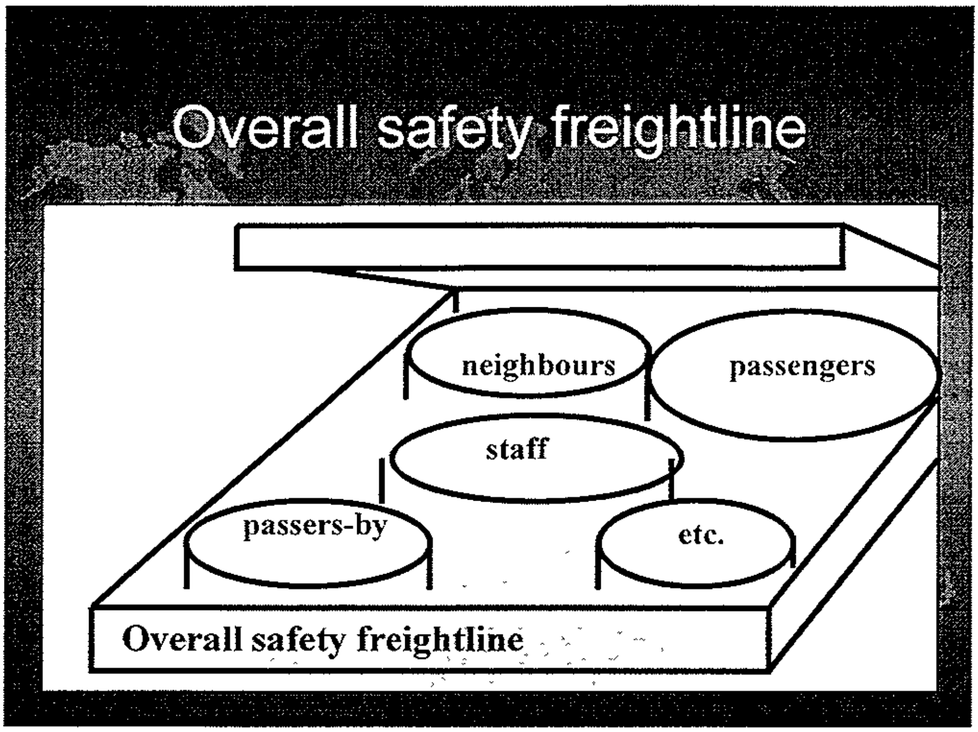
Economics Transport capacity Capital expenditure employment Safety

5.1 Classification of the safety contributions

In addition to the already defined at-risk groups, the freight transport axis can be broken down into the following part systems:



At-risk groups:

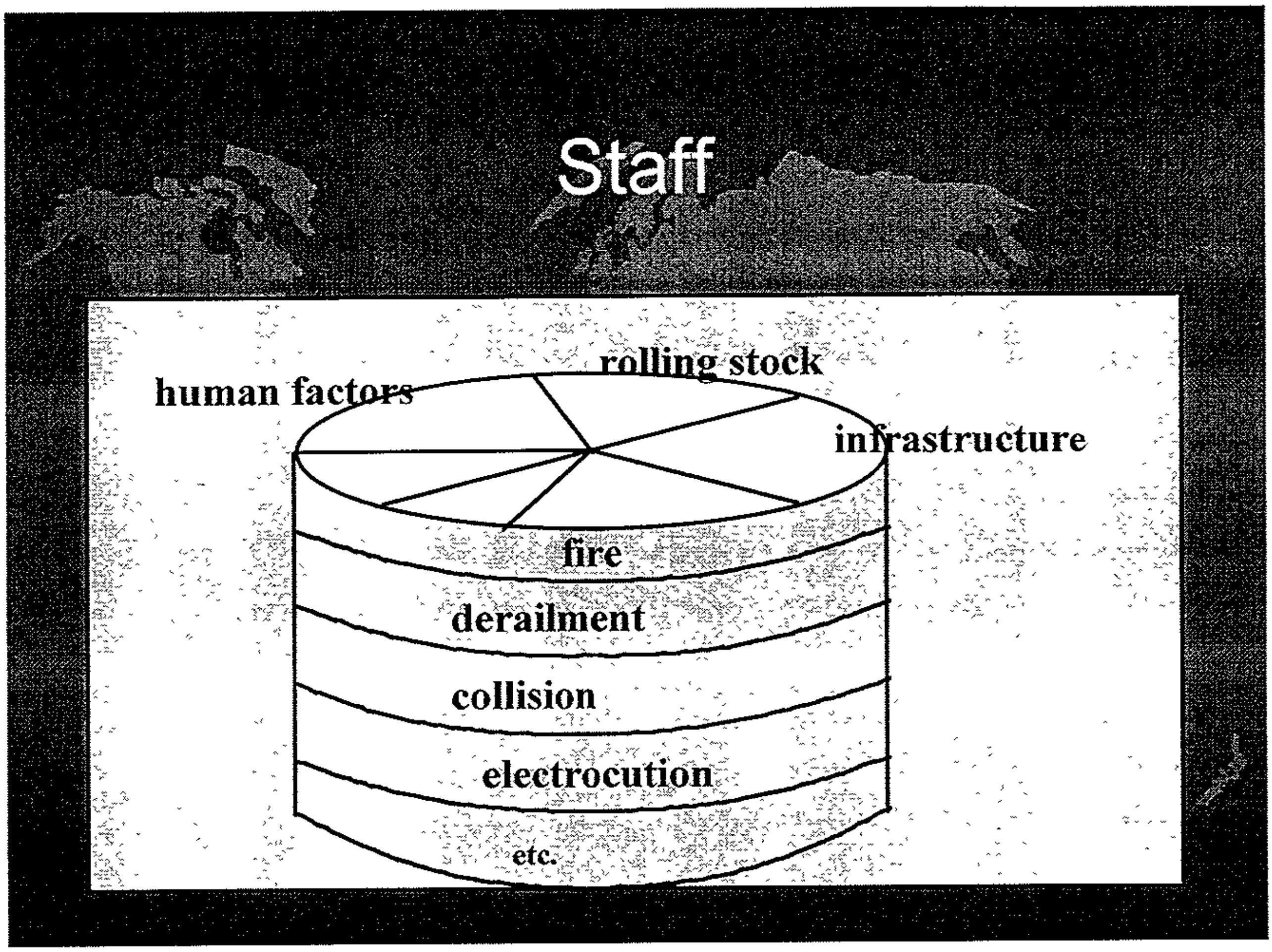


Part systems:

- **Infrastructure**
- **Rolling stock**
- **Traffic control**
- **Track safety**
- **Train safety**
- **Management resources/additional resources**
- **Process operation**

5.2 Composition of the safety matrix

The safety matrix identifies the risk contribution of each of the part systems, for each risk group, for each peak incident/cause.
This breakdown can be presented in a so-called "safety matrix".



train safety
process operation
traffic control
track safety
R. stock.
infrastructure

SAFETY MATRIX:

Contribution of the system component "rolling stock" to the unsafety in respect of falling parts

system component rolling stock

Table 2: Safety matrix

Risk group	Infra-structure	Rolling stock	Traffic control	Track safety	Train safety	Process operation	TOTAL [N] or %
End-on collisions							
Derailment							
Electrocution							
Falling parts							
Pressure waves							
Hazardous substances							
Fire							
Slanting collisions							
Other							
TOTAL V risk group	1.1%	4.66%	13.93%	4.01%		76.66%	ΣN = 100%

Occurence or incident threatening the safety of the risk group

Total contribution of the system component traffic control to the (un)safety of this risk group

Total (un)safety for this risk group

6 Risk analysis

For each risk group, i.e. for each matrix, for every peak incident, an analysis is carried out into all possible causes which may make a contribution to the occurrence of the peak incident.
The analysis covers human action, influences from the environment, and the lack or failure of the technical safety functions in the system, in relation to design, or implementation as achieved.

The thus produced details also clearly present how the risk of occurrence of a specific deviation in one of the system components need not necessarily result in the incident in question, but in combination with the risk of occurrence of a deviation in another system component *may well* result in an excessively high risk of occurrence of that incident.

The total risk can be calculated from the sum of the risks of the system components which contribute to the incident (in the matrix: *horizontal spread across the columns*). It is also possible to quantify the cost share already included in the design of the system component in question, aimed at achieving the predetermined, existing safety contribution.
In this way, the fields in the matrix for each peak incident are completed with the risk contributions and the safety costs of the design cluster, for the peak incident in question.

Risk group	Infra-structure	Rolling stock	Traffic control	Track safety	Train safety	Process operation	Other	TOTAL [N] or %
End-on collisions								
Derailment								
Electrocution								
Falling parts								
Pressure waves								
Hazardous substances								
Fire								
Slanting collisions								
Other								
TOTAL V risk group	1.1 %	4.66 %	13.93 %	4.01%		67.61%	9.05%	100 %

Passengers:

Risk group	Infra-structure	Rolling stock	Traffic control	Track safety	Train safety	Process operation	Other	TOTAL [N] or %
End-on collisions								
Derailment								
Electrocution								
Falling parts								
Pressure waves								
Hazardous substances								
Fire								
Slanting collisions								
Other								
Passengers per year	0.18	0.39	in process operation	0.11		1.92	0	2.6 fatalities
TOTAL V passengers	7 %	15 %	~	4 %		74 %	0 %	100 %

Total per year; all at-risk groups:

Part systems: Risk group	Infra-structure	Rolling stock	Traffic control	Track safety	Train safety	Process operation	Other	TOTAL [N] or %
Passengers								2.6
Train-cew								0.4
Railway workers								2.0
neighbours								0.07
passers-by								1.14
TOTAL	9 %	7 %	In process operation	5 %		79 %	~	100 % [6.21]

7 Reference documents

[1] Routing decision; determined on 26 November 1996 by the Minister of Transport, Public Works and Water Management and the Minister of Public Housing, Spacial Planning and the Environment.

[2] Minister of *Public Housing, Spacial Planning* and the Environment, and Transport, Public Works and Water Management, RISK STANDARDS FOR THE TRANSPORT OF HAZARDOUS SUBSTANCES, a balance between transport, safety and the environment, published by DGV (Directorate-General for Transport), February 1996.

[3] HSL-South, Overall Safety Plan, RWS (Department of Public Works) Construction Service, RWS HSLV-R-97001, 27 January 1997.

[4] Overall Safety Plan, Railned, RnV/U11/100/010, 6 March 1997.

[5] Strategic policy plan on Railway Safety, 1997-2001, Railned Railway Safety, 28 August 1996.

International Rail Safety Conference

1997 LUCERNE

21 May - 23 May 1997
Swiss Transport Museum, Lucerne, Switzerland

Paper 9722

Herman Bruwer

The social Impact of the Transportation of Dangerous Goods by Railway

Publisher
2000 International Rail Safety Conference

Schweizerische Bundesbahnen
Chemin de fer fédéraux suisses
Ferrovie federali svizzere
Swiss Federal Railways

INTERNATIONAL RAILWAY SAFETY CONFERENCE (IRSC) 1997
21 to 23 May, Lucerne / Switzerland

PAPER: Risk Management
The social Impact of the Transportation of Dangerous Goods by Railway

PRESENTED BY: Mr. Herman Bruwer
Manager Risk Management

DATE: 22.05.97

SESSION: VII

TIME: 1400-1430

THE SOCIAL IMPACT OF THE TRANSPORTATION OF DANGEROUS GOODS BY RAILWAY
A
SPOORNET EXPERIENCE

PRESENTER :

H BRUWER
MANAGER
RISK MANAGEMENT
SPOORNET

CURRICULUM VITAE

BPH BRUWER

Herman Bruwer started his career with Spoornet in 1974 as a train driver's assistant where he gained first hand experience of practical trains working and the conditions governing the lives of train crews.

Since 1979 to 1989 Herman was deployed as an operating clerk where he worked in various practical positions, e.g. Telex operator, Yard planning officer, Station Foreman and Train operating controller in one of the major centralized traffic control offices.

During the period 1985 to 1988 Herman studied part-time at the University of South Africa and obtained a BCom degree.

Herman started off his career at Spoornet Head Office in 1990 as Business Manager in the Main Line Passenger Services section where he was co-responsible for the repositioning of Spoornet's intercity passenger train service in a deregulated passenger transport market. He was also responsible for the positioning of Main Line Passenger Services in neighbouring countries such as Botswana, Zimbabwe and Mozambique.

In 1993 Herman was promoted to his current position at Risk Management where he gained expertise in the development of Railway Legislation and the establishment of Risk Communication programmes. In 1996 he was the convenor of the International Railway Safety Conference in Cape Town.

Herman is currently working on risk assessment projects which will enable Spoornet to have risk profiles developed for most of its routes over which dangerous goods are transported.

TRANSPORTATION OF DANGEROUS GOODS BY RAILWAY

SYNOPSIS

This paper deals with the risk profiling of a railway line for the transportation of dangerous goods through the application of TRIMIT (Transport Risk Minimisation Tool) to determine: (a) the **impact** of risk exposures on society at large and (b) how to **manage** those risk exposures which impact negatively on society.

It is also intended that this paper should invite participation from delegates in establishing an acceptable norm for the transportation of dangerous goods against which individual railways can benchmark using the principles of "ALARP" (as low as reasonably practical).

References

J. de Villiers, Spoornet	TRIMIT Benchmarking Task Group Report, April 1996
DNV Technica Ltd	Dangerous Goods Risk Assessment, November 1994

1. INTRODUCTION

The transport of dangerous goods is a very emotive subject as members of the public are adverse to undertakings which appear to place them at risk and from which they derive no direct benefit. With fixed chemical installations they have the option to live elsewhere but with transportation the hazard is always present when they travel or live near a railway line. It is therefore very important that companies like Spoornet should be able to defend business decisions and, if necessary, assure the public, their shareholders, their insurers and the regulatory authorities that decisions they make are sound. Risk analysis and assessment are the keys to good business management; this is particularly true for the transport of dangerous goods.

The risks to humans from the transport of dangerous goods are best expressed as a **'societal risk'**. That is, in terms of the risk of a 'disaster' where the risk is spread over the society as a whole and specifically the group of people along the transport route who may be affected by an incident. While the risk moves along the route, there are some considerable variations in the local levels of risk, where there is an increased likelihood of accidents due to track structures such as points and at other 'hot spots', where there are high densities of populations either beside the rail track or on it as rail passengers. At either end of the transport operation, where the dangerous goods are loaded into the tank car and where the tank car is either discharged or pumped into a ship there is likely to be a increased level of risk. Such concentration points is also commonly found at marshalling yards and sidings along the route where tank cars may be present for considerable periods of time.

Spoornet conveys approximately 9 million tonnes of petrochemical products per annum over its vast rail network of 28 000 route kilometres. The bulk of these products are transported to the ports of Durban and Richards Bay via the coal export line and the Natal Main Line. **[Slide]**

The conclusion of a transport agreement between Spoornet and one of its major suppliers for the annual conveyance of 72 000 tons of Acrylonitrile to Durban harbour initiated a risk profile study for the Natal Main Line. The route considered in this study is from Trichardt to Durban, a distance of about 800 km which traverses many different landscapes and population types. **[Slide]**

This study was, amongst others, intended to identify the exposures to society (passengers and people living / working alongside the railway lines) to the risks imposed upon them due to the transport process. The study also had to reveal the situation of the individual employee working in the vicinity of these products.

Although this was the first risk profile study done in Spoornet for the transportation of dangerous goods, several other routes have since been profiled based on the same principles as will be discussed in this paper. However, while these studies were initiated by Spoornet with the view to determine the **cost of risk** in the transportation of dangerous goods it became apparent that Spoornet is driven by external influences to comply with the recommendations contained in the study. The two most prominent external influences are:

(A) LEGISLATION :

In South Africa Health and Safety is regulated by the "Occupational Health and Safety Act, Act 85 of 1993". The draft bill **"Major Hazard Installation Regulations"** which forms a part of this Act will be promulgated in South Africa late in 1997 requires, amongst others, that a risk assessment to be done.

(B) INTERNATIONAL PROTOCOLS :

The world-wide **Responsible Caer** programme (introduced formally to the South African Chemical Sector in 1994) has been founded on a series of important pro-environmental criteria and practises. One of these is product stewardship, or the practice of better understanding and managing the "cradle to grave" concept of particular products that may or do impact unfavourably on human well-being and the natural environment. One of the pillars on which the Responsible Caer principle is based is the **TRANSCAER PROGRAMME** (Transport Community Awareness and Emergency Response). TRANSCAER is a community outreach programme supported by industries involved with the shipping, manufacturing, distribution, and **transportation** of hazardous materials.

Briefly the principles of Transcaer are to:

- Encourage partnership between citizens and industry to develop an understanding of the hazardous materials moving through the community.
- Help emerging planning groups identify the general types of hazardous materials moving through the community.
- Provide guidance for local officials to develop and evaluate the community emergency.
- Assist with training and testing for emergency preparedness.

In South Africa, the Chemical and Allied Industries Association (CAIA) officially subscribes to the Responsible Caer Programme and therefore requires Spoornet to adhere to the principles of TRANSCAER.

To this extent Spoornet committed itself to the basic TransCaer principles by communicating with Local Authorities within whose jurisdiction Spoornet operates. The Local Authorities would then communicate further to the communities in their constituencies.

2. THE *TRIMIT APPROACH TO RISK PROFILING A RAILWAY LINE FOR THE TRANSPORT OF DANGEROUS GOODS

Spoornet formally approached DNV Technica, England, during 1994 with the broad aims of :

- providing Spoornet with the means to make risk management decisions concerning the transportation of dangerous goods;

- transferring knowledge and understanding to Spoornet staff in order to make risk management decisions;

- specifically, to provide a basis for the decision on the acceptability of the risk emanating from transporting acrylonitrile and;

- the construction and delivery of the TRIMIT software together with a user guide and manual. TRIMIT allows initially the risks from the transport of dangerous goods to be calculated and provides societal risk and individual risk output.

The TRIMIT programme has been created as a PC computer programme which requires the necessary inputs, draws the base risk numbers from a data file, carries out the calculation and produces the risk ratings. The following input data are inherent to the programme :

- the substance (to be transported), its physical state and hazard properties;
- the size and density distribution of "off route" population;
- the number and frequency of passengers on passenger trains also using the rail line;
- specific parameters related to tank size and design, ambient weather conditions, rail signalling;
- length of the route;
- annual trade on the route;
- the length of the route used by passenger trains;
- the presence of risk aggravating or mitigating track features such as turnouts, curves and straight high speed sections.

***TRIMIT : _(Transport Risk Minimisation Tool)_**

The broad approach adopted for the study, followed that which is commonly followed in risk assessments of this nature :

- a thorough audit and review of current practises, standards and operations associated with dangerous goods transport and handling en route was done;
- the risks from all aspects of the operations were modelled on the basis of the information gathered and the judgements made;
- the outputs from the risk analysis were compared with international acceptability and tolerability criteria, to determine the significance of the present levels of risk and whether there remained a need for additional risk reduction measures;
- in particular, a judgement was formed as to whether any other measures which could be reasonably taken to further reduce the risk, so that Spoornet could demonstrate that the new level of risk was at a level which is "as low as is reasonably practical",
- by risk ranking and sensitivity testing, the major contributors to risk were identified and then subjected to fresh risk reduction measures;
- conclusions could then be drawn on the tolerability of the risk levels found and the need for additional risk reduction measures.

To determine many of the required inputs a physical inspection of the entire route was a prerequisite to map and to verify the physical features of the route such as tunnels, bridges, etc. as well as the proximity of industrial and urban development.

3. RISK RESULTS

The output from the risk analysis study represents the level of risk to

- the society
- individuals
- technical and infrastructure
- environment
- capital

For the purpose of this presentation I will not elaborate on all of the above risk exposures, but rather concentrate on the **societal risk exposures.**

Societal risk, in this context, is defined as risk to people who either live near to the railway line or are passengers on it.

Figure 3 (Annexure 1) displays the total societal risk for the route before the transport of Acrylonitrile. **[Slide].**

Figure 4 (Annexure 2) displays the total societal risk for the route after the introduction of Acrylonitrile. **[Slide].**

It is quite evident from the above figures that Spoornet posed a significant societal risk exposure on the route before the introduction of Acrylonitrile and that the risks to both society and passengers, increased with the introduction of Acrylonitrile.

Various **risk reduction measures** were then modelled to determine the influence thereof on the risk profiles.
These measures included the following :

- transportation of the product by day only,
- transportation of the product by night only,
- transportation of passengers by day only,
- transportation of passengers by night only,
- reduced derailments through the introduction of more hotbox detectors and
- improved emergency response.

The result of these risk reduction measures was very informative and the following conclusion could be made; e.g. :

- That it seems safer, overall, to transport acrylonitrile by day rather than night. The reduced dispersion of toxic gases found with stable night-time atmospheric conditions produces much greater all-rail risks compared with the reduction in rail passenger risks.

4. AGGRAVATING FACTORS CONTRIBUTING TO THE RISK PROFILE

(A) Due to South Africa's unique population diversity, especially with the influx of people from neighbouring countries and from the rural areas of South Africa towards our main cities, Spoornet is confronted with **informal settlements** which are spread alongside our railway lines. **(Slide).**

The population density of informal settlements can be seen within the context of the following off-route population category as displayed in TABLE 1 :

TABLE I

Off-Route Population Category

POPULATION CATEGORY	AVERAGE DENSITY (people per km^2)
Urban	**4210**
Sub-urban	**1310**
Built-up Rural	**210**
Rural	**20**
Low Cost Housing	**6250**
Informal Housing	**20000**

For most of the route, a distance of 25m and more separates the railway line and the nearest dwellings. In only a few locations it was found that the dwellings were within 25m of the track.

(B) The following factors contributed individually and collectively to the risk profile, i.e.

(i) Weather conditions, which vary from tropical and mild conditions in Southern Natal to frosty and snowy conditions in the Natal Highlands as well as highlands of Gauteng and Mpumalanga;

(ii) Long distances between stations and towns on the route with little or no facilities available to handle incidents where dangerous goods are involved;

(iii) Low levels of education and understanding of people (living alongside the route, especially in the informal settlements) regarding the risks of the products transported;

(iv) Lack of knowledge and training of train crews with respect to the various properties of hazardous materials transported;

(v) Inaccessibility of the railway line, in various locations, by road transport should an incident involving dangerous goods occur;

(vi) Lack of communication between various local authorities and informal settlements.

(vii) Inadequate Fire and Emergency Services at local authorities spread along the route with little or no adequate equipment available, and

(viii) Existence of intercity passenger trains on most of the route.

5. RISK ACCEPTANCE

(i) Dilemma

Confronted by the results of the risk profile study Spoornet needed a yardstick against which it could benchmark the output of the study in order to determine the levels of "acceptability" of the profile.

As previously stated, health and safety at the workplace is regulated by the Department of Labour in South Africa. The only risk criteria to which the Department of Labour is willing to commit themselves are those stipulated in the Occupational Health and Safety Act, Act 85 of 1993 which pertains to **"reasonably practical"** and states the following :

"Reasonably practical", means practical having regard to -

(a) the severity and scope of the hazard or risk concerned;

(b) the state of knowledge reasonably available concerning that hazard or risk and of any means of removing or mitigating that hazard or risk;

(c) the availability and suitability of means to remove or mitigate that hazard or risk; and

(d) the cost of removing or mitigating that hazard or risk in relation to the benefits deriving therefrom.

(ii) Taking into consideration the abovementioned criteria and considering the fact that no suitable (railway specific) risk criteria could be found to benchmark our risk profile, Spoornet decided to accept the **recommendations** of the risk profile, to manage the risk distribution curve for the total route in question and to reassess the route over a period of time. New studies are now being undertaken to determine risk profile limits.

6. MANAGING SOCIETAL RISKS

This is the first attempt by Spoornet to set safety standards for societal risk exposures and therefore it has been decided to take a three pronged approach to manage societal risk, e.g.

- Education and sensitising of local authorities along the route with respect to hazardous commodities transported by rail. By doing this Spoornet subscribes to the principles of TransCaer;

- To train and educate train personnel and operating staff in specialized emergency response measures;

- Equipping exposed personnel with suitable personal protective equipment.

(A) EDUCATION AND SENSITIVITY OF LOCAL AUTHORITIES

1. As a point of departure Spoornet had to establish the exact locations of the various Fire and Emergency Services of Local Authorities spread along the whole route. On this route 22 local authorities were identified.

2. The purpose was to :

    - **Inform** the Local Authorities of the various hazardous goods which are transported over their area of jurisdiction
    - Ensure that Local Authorities had **emergency plans** available and updated to manage incidents where trains are involved.
    - Ensure that **communication** networks are established between Spoornet and Local Authorities.

3. Specific **agreements** were made between Spoornet and Local Authorities with respect to roles and responsibilities.

    Local Authorities

    - Establishment of a **Joint operational centre**;
    - To determine which hazardous materials are involved;
    - It is expected from Local Authorities to **cordon-off** the scene of the incident;
    - Local authorities should implement their own **emergency/-evacuation** plan if necessary;
    - **Access** control by the Police;
    - **Save** the lives of the train crew; and
    - To **brief** Spoornet Fire and Emergency Services when they arrive at the scene.

    Spoornet

    - Spoornet (Fire and Emergency Services) will react immediately;
    - Spoornet will take over responsibilities of the incident (with Local Authorities as back-up at the scene if necessary);
    - Spoornet will fulfil it's obligations towards the community and the environment.

4. An agreement was reached with one of the suppliers of the product with respect to the following :

   - Provision of a 24 hour emergency information centre
   - Media co-ordination
   - 24 Hour specialist assistance

(B) TRAINING AND EDUCATION OF TRAIN CREW AND OPERATIONAL STAFF

1. Train drivers and their assistants are provided with training in the appropriate steps to take in the event of a dangerous goods emergency. The primary focus here is on getting information out from the scene of the incident as soon as possible and taking steps to prevent other trains becoming involved with the incident and also, if the situation warrants it, to stop road traffic.

2. Train drivers and their assistants are trained to use breathing apparatus to escape with from the scene of the accident.

NOTE :

It should be stressed that the primary duties of the train crew are :

- to warn trackside personnel and summon help;
- to protect their train and to prevent other trains from entering the effected area;
- to convey information to the emergency services on the location of the effected wagons and their content; and
- To stop road traffic and keep the public away, if possible.

NOTE :

The possibility is also being considered that trains conveying dangerous goods should be formally **"handed over"** when they pass into a new train crew's possession. The acceptance of the train by the new crew should only follow a visual **inspection**, by foot, of the train and the critical points on the dangerous goods wagons including bearings, labels and equipment such as hatch covers.

(C) SUPPLEMENTING DOCUMENTATION

To enable the managing of the abovementioned two critical areas Spoornet's **specialists** in the field of HAZMAT and Fire and Emergency Services produced three working documents and training manuals to educate and to sensitize the relevant role-players in the field of transport of dangerous goods.

1. **Southern African Development Community (SADC) Hazardous Materials Handbook.**

This handbook is for use by all railway personnel in Southern Africa involved in the acceptance, handling, loading, unloading, storage and conveyance of hazardous materials from one country to or through another country and constitutes an Inter-Railway standard of carriage of hazardous commodities prescribed in international codes as adopted by the SADC Railway Administration. This handbook is already signed and accepted by the Chairman of the Traffic Committee of the SADC as a protocol. It should also be mentioned that this handbook has been included in the Transport, Communication and Metreological Protocol which is accepted and signed by all the Heads of States of the participating Southern African countries.

2. **The *SOAR training manual.**

This manual is developed to train and to educate train crew and operating personnel with respect to the following:

- identification of the product;
- emergency communication;
- emergency action to be taken;
- evacuation of the area;
- first aid procedures;
- evaluation of the incident;
- evaluation of the surrounding area.

3. **Spoornet Sensitising Document for Local Authorities**

This comprehensive working document was developed and is distributed by Spoornet Fire and Emergency staff during their roadshows to Local Authorities. The document aims at enlightening the Local Authorities on, interalia the following :

- Spoornet's Emergency Plan;
- Safety Instructions : High-voltage Electrical Equipment;
- Product data with respect to all the Hazardous Material;
- Truck labelling and commodity product codes
- Rail tank-wagons and types of rail tank-wagons
    - valve operations
    - filling
    - decanting

SOAR : S = Size-up O = Objective A = Assess R = Re-assess

7. CONCLUSION

1. The societal risk along the route warrants serious management attention. However, the continued management in the areas of emergency response training to train crews and operating staff, as well as information sharing with local authorities with respect to the co-ordination of efforts at incidents, will positively influence the risk profile in the short and medium term.

2. TRIMIT is a flexible and excellent tool for risk assessment of dangerous goods in transit and renders itself ideal for modelling risk reduction measures for societal and individual risk.

3. Spoornet takes cognisance of being an operator in a developing country but strives towards best practices, service excellence and to fulfil its moral obligation towards all stakeholders and the environment in its broadest context. However, the absence of a norm with respect to the acceptability/unacceptability of risks in the transportation of dangerous goods by rail creates a gap which will have to be addressed in the near future.

4. This study has equipped Spoornet with the knowledge and understanding of its risk exposures as well as the various contributors thereto. This is a manifestation of the philosophy that risks can only be managed once they are properly understood and assessed.

8. EPILOGUE

To enhance Spoornet's knowledge in the field of dangerous goods transport the following studies are currently underway, e.g.

- Gas fumes in railway tunnels
- Explosives risk study
- Risk profiling of dangerous goods in static environments, i.e. marshalling yards and private sidings.

9. NOTE

In order for Spoornet to benchmark their risk profiles, conference delegates are invited to correspond their own progress with risk profiling the transportation of dangerous goods and their management efforts to minimise societal risk.

FIGURE 3 ANNEXURE 1

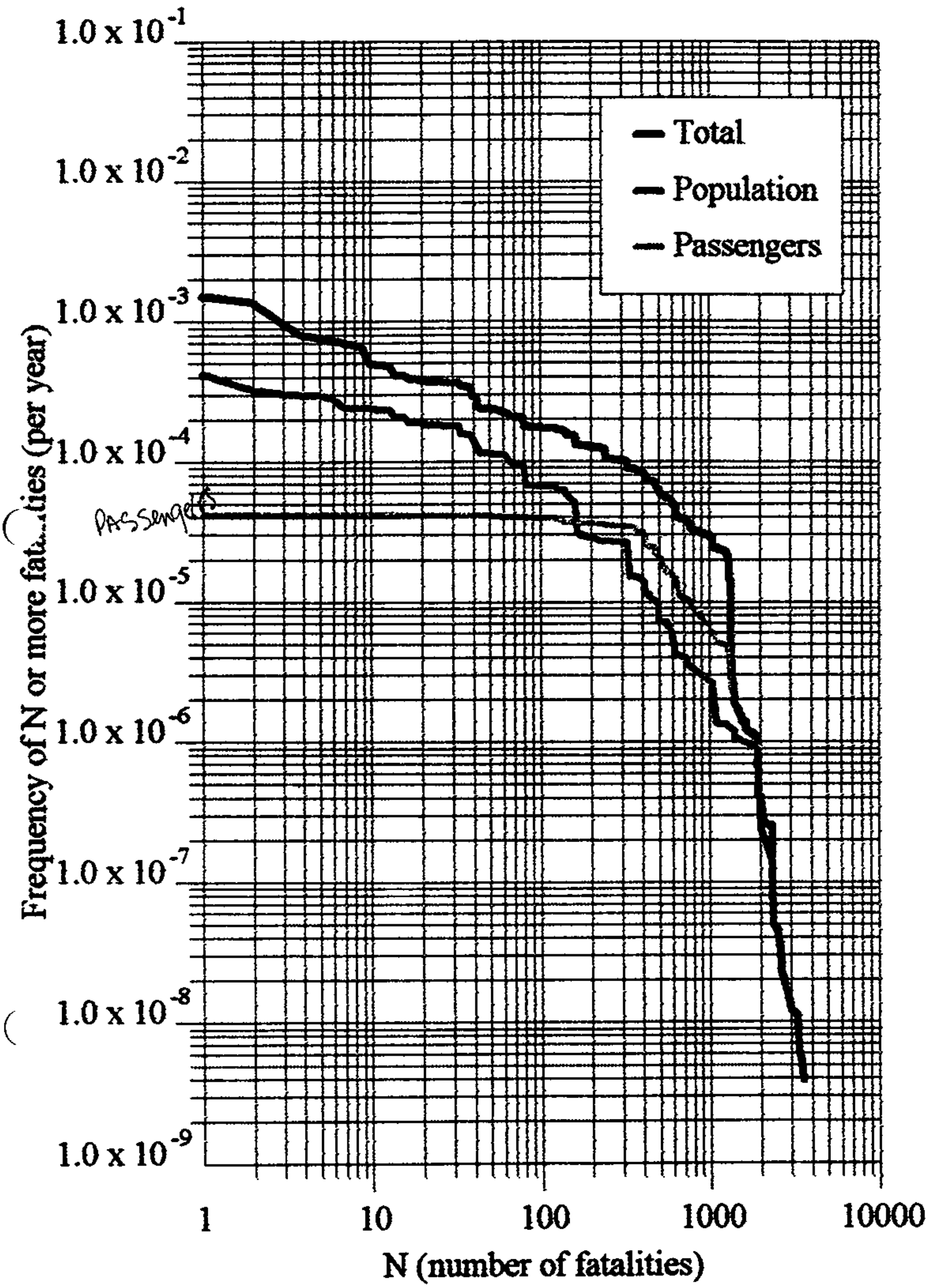
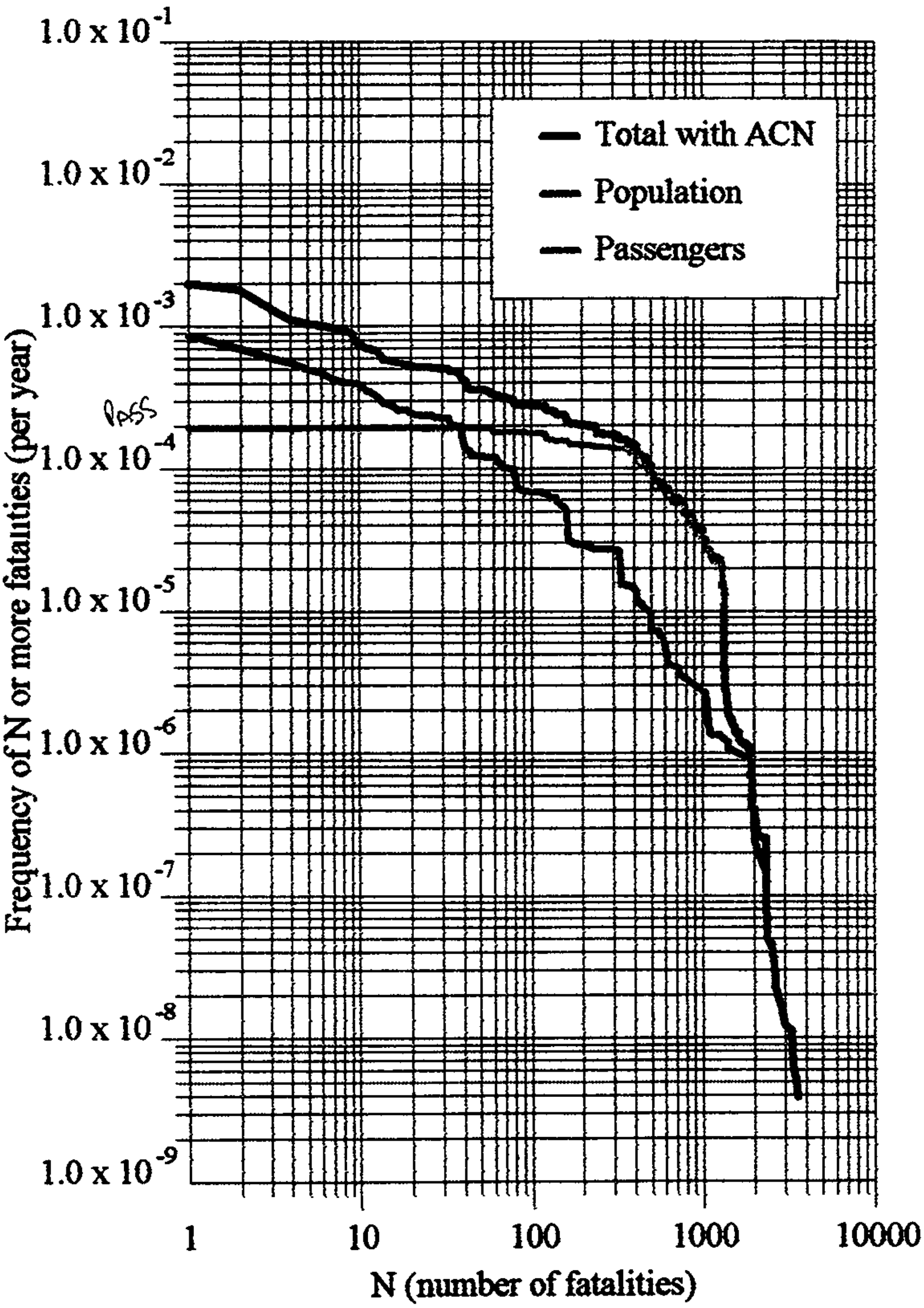


FIGURE 4 **ANNEXURE 2**



International Rail Safety Conference

1997 LUCERNE

21 May - 23 May 1997
Swiss Transport Museum, Lucerne, Switzerland

Paper 9723

Dieter Reuter

Human Factor: Strategies for Preventing the Causes

Publisher
2000 International Rail Safety Conference

Schweizerische Bundesbahnen
Chemin de fer fédéraux suisses
Ferrovie federali svizzere
Swiss Federal Railways

INTERNATIONAL RAILWAY SAFETY CONFERENCE (IRSC) 1997
21 to 23 May, Lucerne / Switzerland

PAPER:	**Human Factor** **Strategies for Preventing the Causes**
PRESENTED BY:	**Mr. D.Reuter** **Safety Manager**
DATE:	**22.05.97**
SESSION:	**VII**
TIME:	**1430-1500**

Dieter Reuter, Deutsche Bahn AG

--> Dipl.-Verwaltungsbetriebswirt (Bundesbahndirektor) in Rail Network Division, Frankfurt am Main

--> Manager in the Chief-Department for operational safety and deputy of the Chief Manager

--> Functions and experiences in tasks of updating rules and regelations for operationel safety

--> Member of project-groups

- o Development of struktures for operational safety offices
- o New Organisation in Rail Network Division

__Translated from German__

International Railway Safety Conference 1997

Signals passed at danger

- Strategies for preventing the causes
- Video "Markus and the language of signals"

Dieter Reuter
Safety Management
Deutsche Bahn AG
Network Sector
Frankfurt am Main

I.

Railways should be safe. It is the responsibility of the railway undertaking to comply with this basic safety requirement. Starting of trains against signals at danger after stopping at the platform is a recognised cause of accidents in railway operation. This problem needs to be addressed.

The railway experts are keen to introduce technical measures to reduce the risk for trains when drivers pass signals at danger. In previous years much research and analysis of special statistical records enabled potential dangers to be uncovered and the way found to extend the inductive automatic train control system.

On Deutsche Bahn AG most of the lines have intermittent automatic train control and it is only on the high speed lines (more than 160 km/h) that continuous automatic train control is installed.

As part of the reunification of Deutsche Bundesbahn and Deutsche Reichsbahn the harmonisation and the extension of intermittent automatic train control was pushed forward energetically.

It should be pointed out that the performance features of the induction based intermittent automatic train control system ("Indusi" and "PZB 90") have been considerably improved.

II.

The measures introduced for the step by step completion of the lines with 500 Hz rail magnets for automatic train control, as well as the fitting of leading vehicles with PZB 90 vehicle equipment cannot, however, be completed in the short term. Therefore, in the meantime, efforts are being concentrated on the measures to do with the staff (the human factor), in order to minimise as far as possible the mishandling of trains by train crews.

This is about a safe handling procedure before a train leaves the platform. It is appropriate to explain the recognised chain of events when staff mishandle trains in order that the staff concerned should be aware of them.

When a train is started against a signal at danger after stopping at the platform a contributory cause is frequently the giving of the starting signal too early by the platform inspector (conductor).

Observations of how the accidents happened, over many years, always show a principle cause, which in the summary version of the investigation reports runs as follows: "Conductor gave the starting signal and the driver did not observe that the signal was at danger".

Negative trends in the accident statistics must be broken. The starting point for this is the results of a statistical recording of these events begun again in 1994.

The business areas, which are responsible for the training and supervision of train crew are being asked to help prevent this problem.

Drivers who have not attended the obligatory regular training course, lose their licence to drive. In 1996 the standard procedure for punishments was modified (made more severe).

The Traction Business sector has arranged to carry out additional accompanying runs on the suburban services that run on single track lines; Quality advisors of the Network Business sector are instructed to check how the train crew and local staff work together (agreement of the Movement Inspector to the departure, ready to depart, starting signal).

III.

The strategy of Deutsche Bahn AG to prevent the causes involves:

- Fitting further safety equipment to the network (e.g. train control equipment, train radio, modernising of the signal equipment). This is done as part of programmes which are basically already approved but some are still being developed.

- More intensive training of drivers by using driving simulators.

Motivation campaigns to deal with the type of accidents caused by "starting against signals that are at danger.

o "Internal publicity" notices (messroom notice boards)

o Checking how the driver handles the train by tutor drivers riding with the driver

o Motivation film, including media releases.

IV.

The most important aspect of this contribution is the presentation of the video "Markus and the language of signals".

It is hoped that showing this film will motivate

* the driver → not to start the train when the signals are at danger

* the platform inspector → only to give the starting signal to the driver when the corresponding signal allows this or the express agreement of the responsible movements inspector has been given.

The video is being shown in the regular training sessions and used as part of the tuition. Personal copies are being given to the staff*.

---

*) Obviously the railways that attend the International Railway Safety Conference will be given a video cassette.

International Rail Safety Conference

1997 LUCERNE

21 May - 23 May 1997
Swiss Transport Museum, Lucerne, Switzerland

Paper 9724

H. R. Lehmann

Safety Management and ISO-Certification

Publisher
2000 International Rail Safety Conference

Schweizerische Bundesbahnen
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INTERNATIONAL RAILWAY SAFETY CONFERENCE (IRSC) 1997
21 to 23 May, Lucerne / Switzerland

PAPER: **Safety Management**
Safety Management and ISO-Certification

PRESENTED BY: **Mr. HR. Lehmann**
Quality Manager Rolling Stock Division

DATE: **22.05.97**

SESSION: **VII**

TIME: **1500-1530**

SBB CFF FFS

International Railway Safety Conference Lucerne

Safety Management and ISO - Certification

Ladies and gentlemen,

It is a great pleasure for me to present to you in the name of the Swiss Federal Railways - SBB - their project "Safety and Quality Management for Dangerous Goods Trains".

1. Starting situation

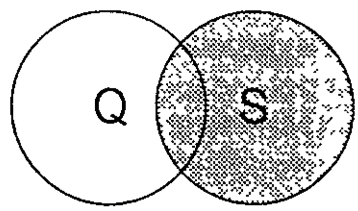
The year 1994 was a difficult year for the SBB because of a singular accumulation of serious accidents. This led to a multi-annual safety programme "Sicherheitsprogramm 95", and to a multitude of corrective activities. One of these was the start for setting up a comprehensive management system for the transportation of dangerous goods along the guidelines of the ISO quality standard 9001.

What were the reasons for this project?

- Major clients peremptorily demanded from us that we build up a quality assurance based on ISO 9000.
- Always more transport providers use their certification in their effort to attract potential clients, thereby lessening our competitivity and prompting us to act.
- The SBB have a great interest in thoroughly studying the possibilities of a management system and to make use of it.

An increasing number of enterprises launched ISO 9000 - projects, and we SBB were of opinion that if they can do it, we can do it also.

Right from the start we agreed on one thing: speaking of *quality, means also* speaking of *safety.*
At a railway enterprise, the concepts of quality and safety are in many fields inseparably interconnected.

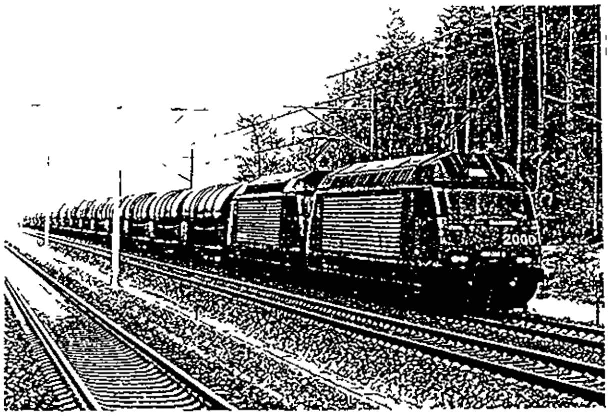


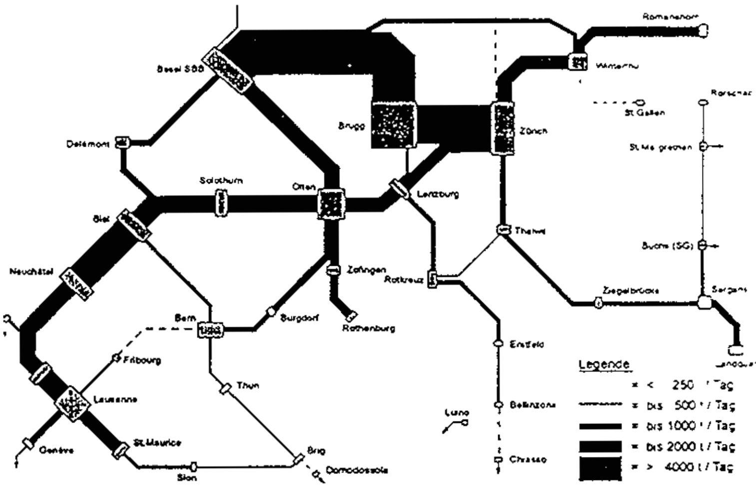
2. Pilot project

Although we were setting up a project for the whole traffic of dangerous goods, we concentrated our efforts first on a pilot project answering the following criteria description:

- the project must be easy to survey, from the point of view of both the product and the geography,
- it must give the possibility to involve as many as possible of the company sectors in the project.

With these conditions, the subject to study was quickly found. Because of the high transport volumes, we chose the transports of mineral oil products, namely the transports of petrol, fuel oil, kerosene, etc. Geographically, we concentrated on the transport flows between Basel and the Zurich area.





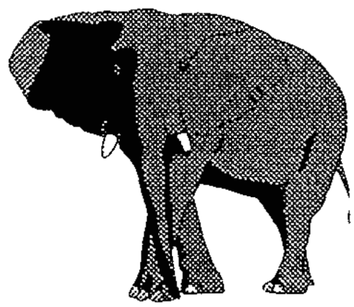
3 What is ISO?

ISO 9001 is a standardization work based on 20 points, comparable to the former philosophy of quality assurance at the private firms. These standards have their origin mostly in the industrial environment. When they were set up, surely no one thought of a possible application in a railway environment. However, the transposition is not as difficult as that. Here an example:

Point 12 of the standards 9001 and 9002 demands under the title control status, that a company must be able to prove the control status at any time. At the SBB, the analogy lies for instance in a goods transport coming into Switzerland at Basel, and having to undergo a multitude of treatments like technical control, operational process, commercial treatment, customs clearance, possibly veterinary control, etc. The railway must at any time be able to prove what treatment a transport has gone through already, resp. what treatment has yet to be carried out.

Apart from this transposition in analogies, we can profit from an extremely interesting development currently taking place: that of an increasing orientation of the ISO standards 9000 to a process-oriented view. We like to explain this using the example of the elephant.

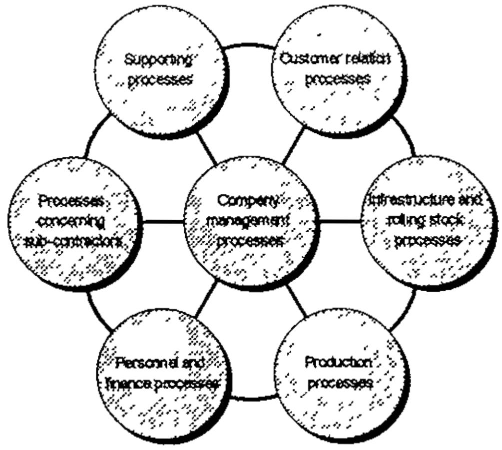
It is not so any more that a simple pattern is laid over the company structures. The focus is on the individual functions of the animal, resp the company: on its trunk, legs, tusks, but also its eyes and ears. These elements, functioning more or less well, are the basis for the animal's health, resp. the functioning of the company. If we transpose this view to the SBB, we see that we in our movements, the pulsation in our veins, the information flows, the functioning of our processes, are not so much different at all.



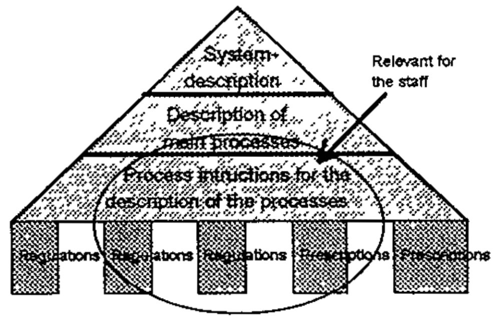
4. Procedural steps

So we began to analyse our processes. We broke up the different activities of our company, formed groups of processes, and joined them again as systematically as possible to form a new order.

These processes have been carefully studied and described, until we arrived at the level of the personnel actually working in the trackyards, in the locomotives and in the signalboxes. This work took about half a year and was the core part of the ISO project.

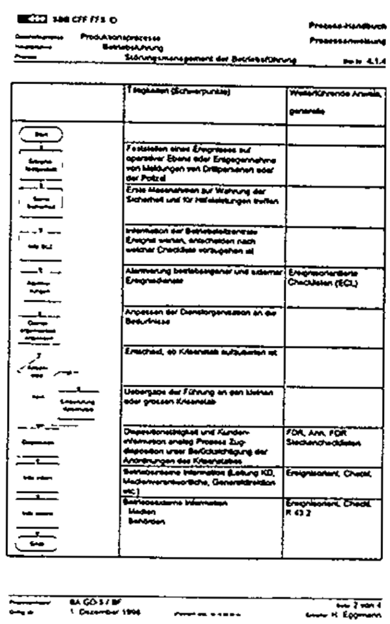


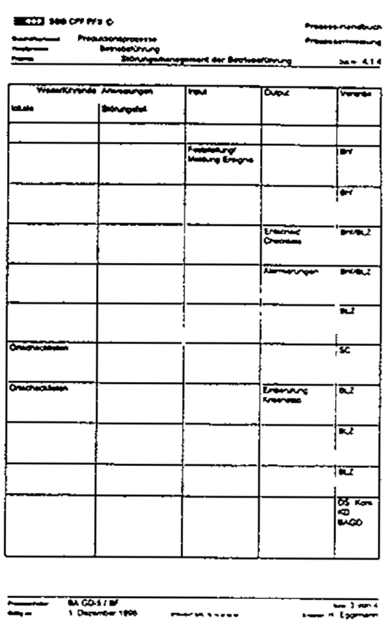
How does this process hierarchy look like?



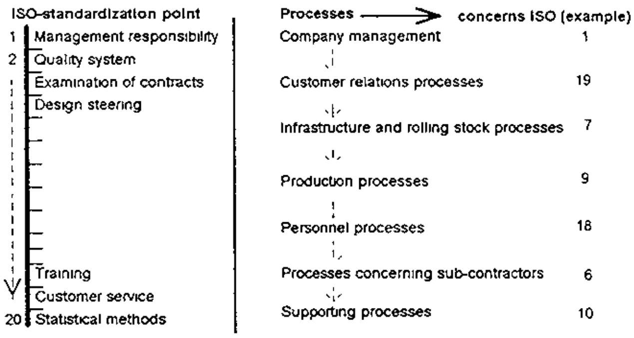
The regulations and prescriptions constitute the basework. They have to define the extent of our safety, resp. of our quality. Based on this, the process descriptions concern essentially the following items:

- the setting of the task, the definition of the services or lines to which they apply, and overriding documentation;
- the procedures proper;
- instructions leading further, precisely the regulations and prescriptions;
- identification of responsibilities, those responsible for the procedural development proper, as well as those responsible for the execution at the place of action.
- the interfaces and junctures to other processes;
- important standards and indexes.

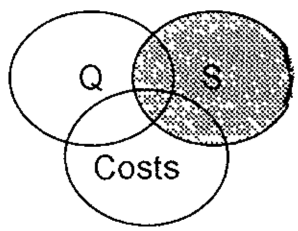




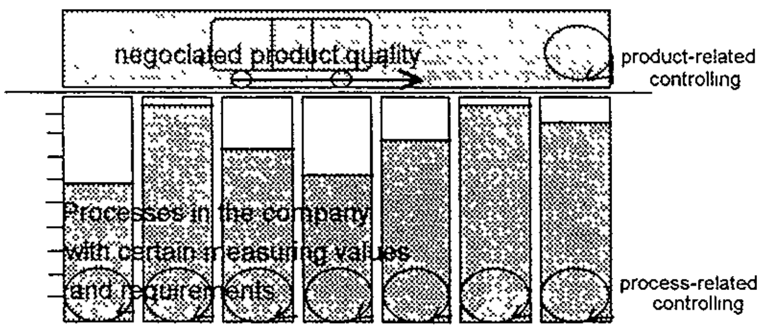
These processes allow a multitude of applications They form the basis for the organisation. By checking them, it can be examined if the reglementation level of specific tasks is too high or - more seldom - too low. These are neutral processes with which the cross-linkage to a multitude of systems or standards is possible. Therefore not only to ISO 9001, but also for instance to 14000 or to procedural safety.



The processes in the enterprise determine not only the performance, but also the costs. The longer we worked on the project, the clearer it was revealed that quality and safety, together with the costs, form an inseparable trio.



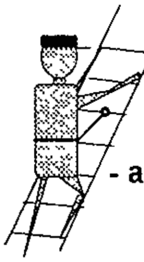
In quality assurance, the quality of the product and the quality of the process must be viewed separately. The quality of the product is a function of the client-needs. The quality of the processes defines, jointly with the authoritative standards, the costs and the safety to a large extent.



5. Findings

In summer 1996, the first phase of the project was terminated and was subjected to a thorough examination by the company SQS. The examination is on the one hand a pre-requisite for the official certification, on the other hand it is also important for our enterprise. Only an audit by an outside organisation shows if the system stands up to the standards of external quality specialists. It is enormously important which firm is commissioned with the audit. This shall be shown on the following example:
When assessing the presumed expenditure of time, the auditors of SQS calculated for the Basel marshalling yard 3 hours, and for a workshop with a workforce of 20 people, 1 day. This for the simple reason that they had no idea of the complexity of a marshalling yard. These auditing firms must therefore build up a railway-specific know-how, like they do for banks or insurance companies.

All activities have one central goal, namely the **mastery of the processes**



-supply required quality

- absolute safety when putting into practice

Mastery of the processes makes them safe. It is a pre-requisite for furnishing the quality. It is also the basis for a cost-effective production, and thus also for the survival of the company.

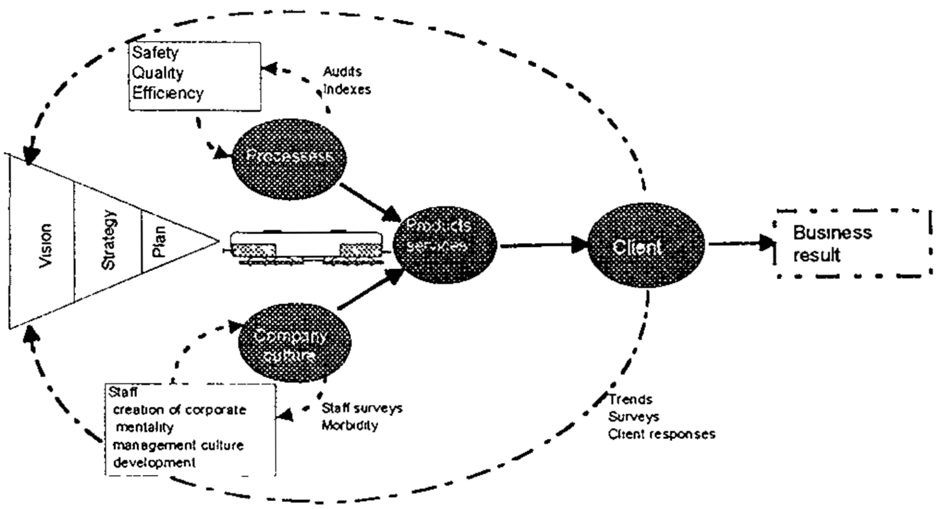
6. Company culture

Yet process mastery alone is not sufficient. Additionally, the working environment must be right, and the staff must have the right attitude to their work and their firm, therefore must have the right **mentality.** Take the example of an official selling tickets behind a counter: not only must he or she master the sales desk computer and the tariffs, but on top of that must also be friendly towards the customers.
This important aspect has been taken into consideration under the title **Total Quality Mentality** when we trained our personnel that is involved in the project.

- **Process Mastery**

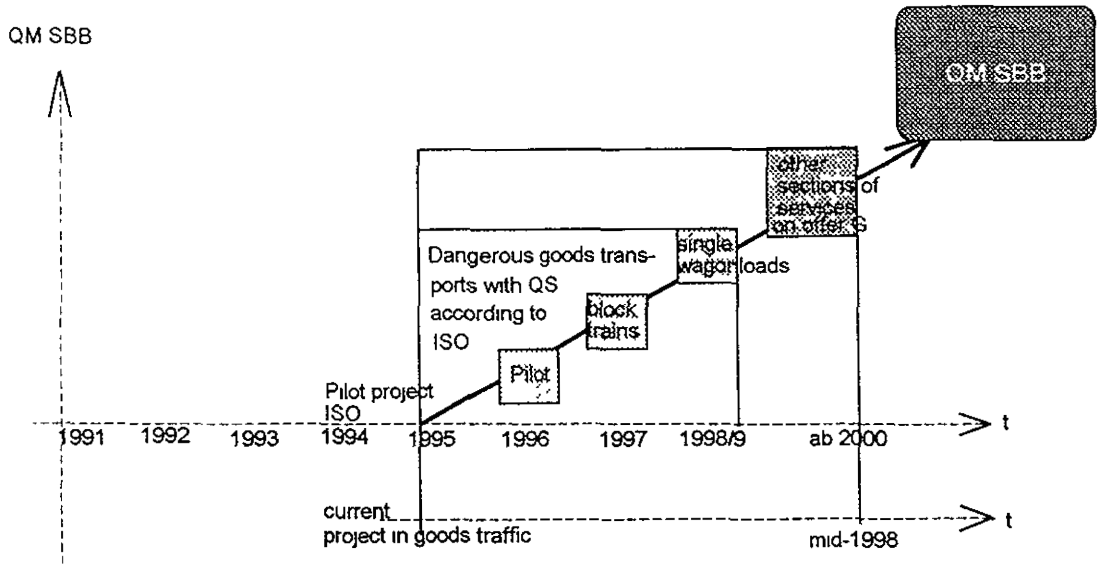
- **Total Quality Mentality**

This aspect is so crucial that for the following project steps, it must be incorporated into the company model, and must be promoted as a part of the company culture.



7. Further procedure

Where do we stand now? Based on experiences with the pilot project, the General direction has decided that the system must be taken futher and be extended to the whole goods traffic until mid-1998.



By taking the transportation of dangerous goods as benchmark for quality assurance, *the measuring pole must be laid high enough so that other less sensitive transports* can also be included without problems.

The points of main effort of the next project step are for instance:

- practical application SBB-wide, and in three languages; German French Italian
- co-operation with partner railways in and outside of Switzerland;
- inclusion of the marshalling yards;
- further fields of rolling stock maintenance and the infrastructure;
- accounting and invoicing of the conveyances.

8. Conclusions

We are convinced that with this comprehensive quality assurance, we are taking an important step towards the future of our enterprise. Granted that it is necessary to always newly awaken the understanding for it within the company, granted that it is necessary to always newly substantiate its meaning and purpose. But the expenditure of time and energy is definitely worthwhile, because it is a pre-requisite in the company for a continuous improvement of the quality and the safety.

International Rail Safety Conference

1997 LUCERNE

21 May - 23 May 1997
Swiss Transport Museum, Lucerne, Switzerland

Paper 9725

Ben Keen
Graham Arkwright

Risk Based Safety Management

Note: *As this was an interactive verbal presentation, no written paper is available.*

Publisher
2000 International Rail Safety Conference

Schweizerische Bundesbahnen
Chemin de fer fédéraux suisses
Ferrovie federali svizzere
Swiss Federal Railways

INTERNATIONAL RAILWAY SAFETY CONFERENCE (IRSC) 1997
21 to 23 May, Lucerne / Switzerland

PAPER:	Safety Management Risk based Safety Management
PRESENTED BY:	Mr. B.Keen Head of Safety Review and Mr. G.Arkwright Safety Policy Adviser
DATE:	22.05.97
SESSION:	VIII
TIME:	1600-1700

RAILTRACK

Safety & Standards Directorate
M L A Siebert TD BSc CChem MRSC MIOSH
Controller, Safety Assurance

14 May 1997
Dr Hauser, SBB, 00-41-41-512-20-46-80

Ben Keen is the Head of Safety Review, Railtrack Safety & Standards Directorate. He is 37 years old and has worked in the British railway industry for over 20 years. Having started as a trainee signalling technician he progressed through various jobs in signals and telecommunications before moving into a specialist safety post in 1988. He was one of the first to join the British Rail Headquarters Safety Audit Group and transferred into Railtrack at its inception in 1994. Ben's current role is to ensure that train and station operators running on Railtrack lines comply with the commitments made in their Railway Safety Cases as required by UK law.

Graham Arkwright is the Safety Policy Adviser, Railtrack Safety & Standards Directorate. He has 25 years railway experience, mostly with British Railways. His jobs have included working in ticket and parcels offices, HQ commercial offices and a training development role. He joined the BR Safety Directorate in 1991 where he was involved in the safety validation of organisations undergoing organisational change and he joined the Policy Unit of Railtrack S&SD in 1994 when the separation of infrastructure management and train operations occurred in the UK.

His primary role is to manage the production of the Railway Group Safety Plan which sets annual safety performance objectives for the Railway Group, reports on overall safety performance and focuses on safety issues which have been identified through the monitoring and audit processes. He is a member of Railway Safety Case assessment panels which recommend acceptance of potential operators RSCs to the Director, Safety & Standards.

Although he meets regularly with colleagues from some of the European Railways (some of whom are attending this conference) to discuss safety issues common to all of us and to generally share best practice and experience, this is the first major railway conference he has attended.

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Registered in England and Wales No 2904587

1997 LUCERNE

21 May - 23 May 1997
Swiss Transport Museum, Lucerne, Switzerland

Paper 9726

Wong Woh Sung

Escalator Injuries in Railways

Publisher
2000 International Rail Safety Conference

Schweizerische Bundesbahnen
Chemin de fer fédéraux suisses
Ferrovie federali svizzere
Swiss Federal Railways

INTERNATIONAL RAILWAY SAFETY CONFERENCE (IRSC) 1997
21 to 23 May, Lucerne / Switzerland

PAPER:	**Safety Management** **Escalator Injuries in Railways**
PRESENTED BY:	**Mr. Wong Woh Sung** **Manager Safety Services**
DATE:	**22.05.97**
SESSION:	**VIII**
TIME:	**1700-1730**

CURRICULUM VITAE

Wong Woh Sung

Wong Woh Sung is an electrical engineer by training. Having spent 10 years in oil/fire power station projects doing both design and construction phases. Thereafter he spent 5 years with the Mass Rapid Transit Corporation of Singapore for the design and construction for the first Mass Rapid Transit Railway in Singapore where he was responsible for the design and commissioning of the high tension distribution network, DC traction power system and the high speed escalators in the railway.

He subsequently joined the operating company i.e. the Singapore MRT Limited, overseeing one of the maintenance branches for three years. Since 1990, he has headed the Safety Services Department and is responsible for implementing the System Safety Programme Plan including safety audits. The System Safety Programme Plan is the safety management system covering work safety, engineering safety and passenger safety.

ESCALATOR INJURIES IN RAILWAYS

Presented at the
International Railway Safety Conference 1997
Lucerne, Switzerland
21 - 23 May 1997

By:

Wong Woh Sung
Manager, Safety Services
and
Foo Chee Song
Assistant Manager, Safety
Singapore MRT Ltd

1) Introduction

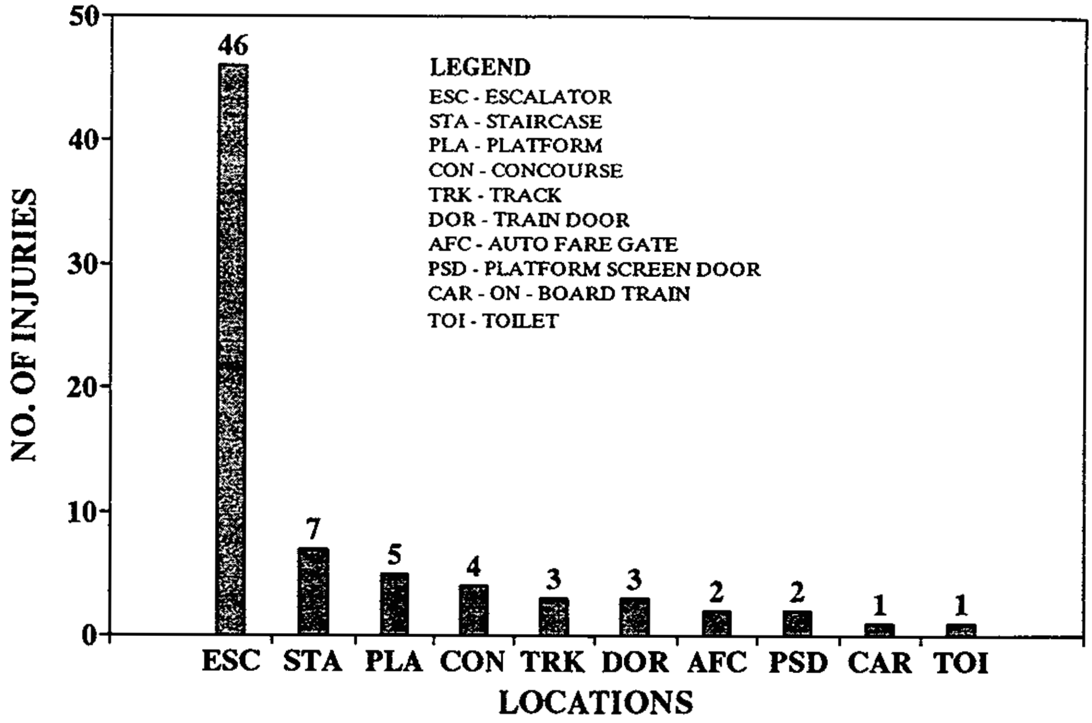
SMRT is the operator of the mass rapid transit system in Singapore with a route length of 83 km, 48 passenger stations and an average daily passenger trip of 885,000 (weekday). There is a reporting system in place to record the unusual happenings in the operation of the system in which one is the passenger injuries. Here, we would like to share with you our analysis on our passenger injury statistics.

2) The SMRT Passenger Injury Statistics

Our station staff will submit written report for every injury case in the railway premises that is brought to their attention or being attended to by them. In capturing these data, we group them into two categories according to the severity of injury, i.e. the above first aid cases (A cases) and the first aid and below cases (B cases). We define A cases as those injuries where the injured persons were sent to hospital by ambulance services.

We set an upper limit on A cases and monitor our safety performance in this aspect. The limit is set at 0.4 injuries per million passenger carried. Our performance attained last financial year is at 0.23. The breakdown of the injuries by locations is shown in Figure 1. One can note that escalator injury is the highest.

Figure 1 - Breakdown of All Passenger Injuries by Locations for FY 96/97 (Above First Aid)



3) The Escalator Injury

In our MRT system we have a total of 290 escalators of which all are operating at 0.75m/s. This speed is 50% higher than the ordinary escalators in shopping centres, offices and hotels in Singapore. Because of the much higher operating speed and escalator injury frequencies is the highest element in our injury statistics, therefore a logical thinking emerges that the high speed of escalators could have resulted in the high injury frequency.

One way to verify this belief is to operate these escalators at a lower speed for a period and then compare the injury frequencies.

However, the speed of our escalators are fixed and could not be slow down without a major and costly modification. Therefore, this is not a feasible approach.

4) The Escalator Survey

We conducted a survey to gather certain specific information from railway operators on their escalator parameters and injury figures with an objective of confirming whether there is a correlation between injury frequency and escalator speeds in a railway environment. The data of the returns are shown in Table 1.

There are differences in these railways and therefore direct comparison of these data is not meaningful. By taking into consideration the following characteristics, we have calculated certain parameters (see para below) from these data so that a more meaningful comparison could be made:

a) Speed and number of escalators

b) Passenger loading

c) Injury frequency

5) The Parameters

5.1 Risk Index

There are 4 types of escalator speeds in the survey returns. The number and speeds of escalators represent the risk exposure levels and they vary widely among the operators. For comparison purposes, we establish a common platform to take into consideration the numbers of speeds of escalators of an operator. This common platform is termed the risk index which is defined as:

$$\text{Individual risk index} = \frac{(1X_A + 1.2Y_A + 1.5Z_A)}{(1X_T + 1.2Y_T + 1.5Z_T) \text{ divided by } N}$$

Where N = total number of operators = 9
X_A = number of escalators operating at 0.5m/s in Railway A
Y_A = number of escalators operating at 0.6 and 0.65m/s in Railway A
Z_A = number of escalators operating at 0.75m/s in Railway A
X_T = total number of escalators operating at 0.5m/s in 9 railways
Y_T = total number of escalators operating at 0.6 and 0.65m/s in 9 railways
Z_T = total number of escalators operating at 0.75m/s in 9 railways

In the formula, we have assumed that the risk is linearly proportional with the quantity and speed of escalators. In the formula, we assign a "Risk Multiplication Factor" to represent the risk level associates with an escalator speed and are as follows:

Escalator Speed	Risk Multiplication Factor
0.5m/s	1
0.6m/s & 0.65m/s	1.2 i.e. Risk is 20% higher than 0.5m/s
0.75m/s	1.5 i.e. Risk is 50% higher than 0.5m/s

5.2 Injury Rate (+E)

Injury frequency represents a measurement on safety performance. The absolute frequencies of injuries would not take into consideration the risk exposure which is relating to the passenger loading and the number of escalators. A conventional injury rate (injuries per 10^6 passengers) could only cater for the factor of passenger loading. In order to take these into consideration, we define below a measuring parameter termed "injury rate (+E)" taking into consideration both the passenger loading and the quantity of escalators:

$$\text{Injury Rate } (+E) = \frac{\text{Injury frequency}}{\text{Passenger trips X no. of escalators}}$$

(Injuries per trillion passenger - escalator)

6) The Analysis

6.1 Speed and Number of Escalators and Risk Indices (Figure 2)

There are four railway operators (known as A, E, F & G) having escalators operating at a high speed of 0.75m/s. Among them, two (E & F) also have a relative large number of escalators operating at 0.6m/s and 0.65m/s. A and G have a small number of escalators operating at 0.5m/s. B, C, D, E, H and I have majority or all of their escalators operating at 0.5m/s. Figure 2 shows the relationships between the risk indices, the speed and number of escalators. The risk index increases with higher speed and higher number of escalators. The risk indices of E, F, G, H and I are higher than the average.

The Figure 2 shows that there is a reasonable correlation between risk index and numbers and speed of escalators.

6.2 Injury Rate and Risk Index (Figure 3)

We define "high" as "above the average" and "low" as "below the average". From the graph, we can group them into the following categories:

Group	Injury Rate	Risk Index	Railway Operator
1	Low	Low	A, B, D
2	High	Low	C
3	Low	High	E, F, G, H
4	High	High	I

One can note that the injury rate for Railway C is exceptionally high.

In summary, there is no consistent trend injury rates and risk indices.

6.3 Injury Rate (+E) and Risk Index (Figure 4)

By the same "high", "low" definitions and from the graph, we can group them into the following categories:

Group	Injury Rate (+ E)	Risk Index	Railway Operator
1	Low	Low	A, B, D
2	High	Low	C
3	Low	High	E, F, G, H
4	High	High	I

Again, one can note that the injury rate (+E) for Railway C is exceptionally high. In summary, one cannot establish a correlation between the injury rate (+E) and the number and speed of escalators which is represented by the risk indices.

6.4 Comparison after Removing the Exceptional Entry from Railway C

The injury data for Railway C is exceptionally high which might have disturbed a patent and thereby made it undetectable.

We re-calculated the survey information without considering the Railway C's data (i.e. N = 8 instead of 9) and the results are shown in Figures 5 and 6.

One can again conclude that there is no consistency between injury rates and risk indices. The same conclusion also applies to injury rates (+E) vs the risk indices.

6.5 Age Profile of Injured Passengers (Figure 7)

There are only six railway operators providing the age profile on passenger injuries. There is consistency in the age profiles (See Figure 7). The majority of injuries were from the older age groups.

7) Conclusion

No evidence could be derived from the information gathered from the survey to support the belief that there is correlation between escalator injury frequency and escalator speed in a mass rapid transit environment.

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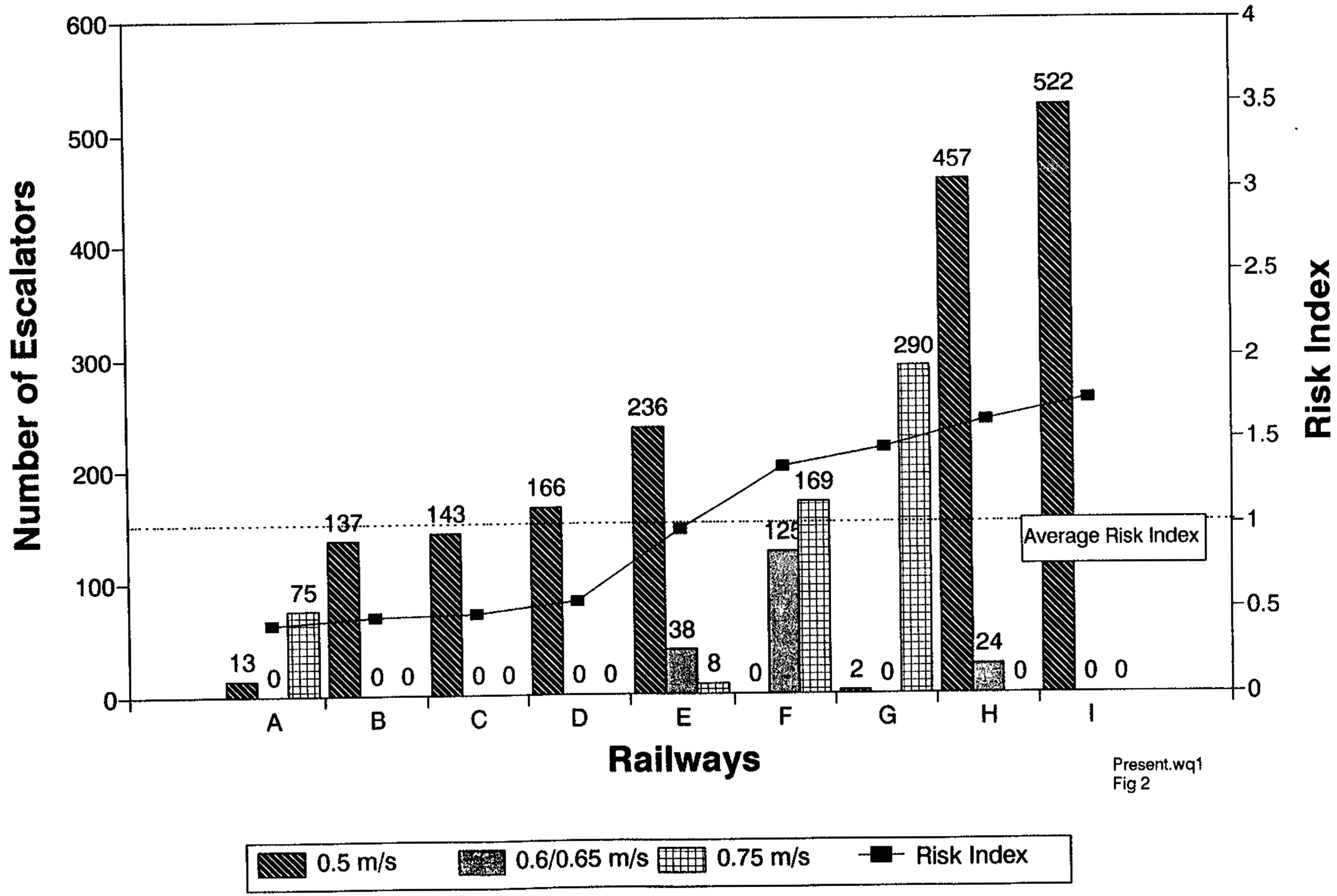
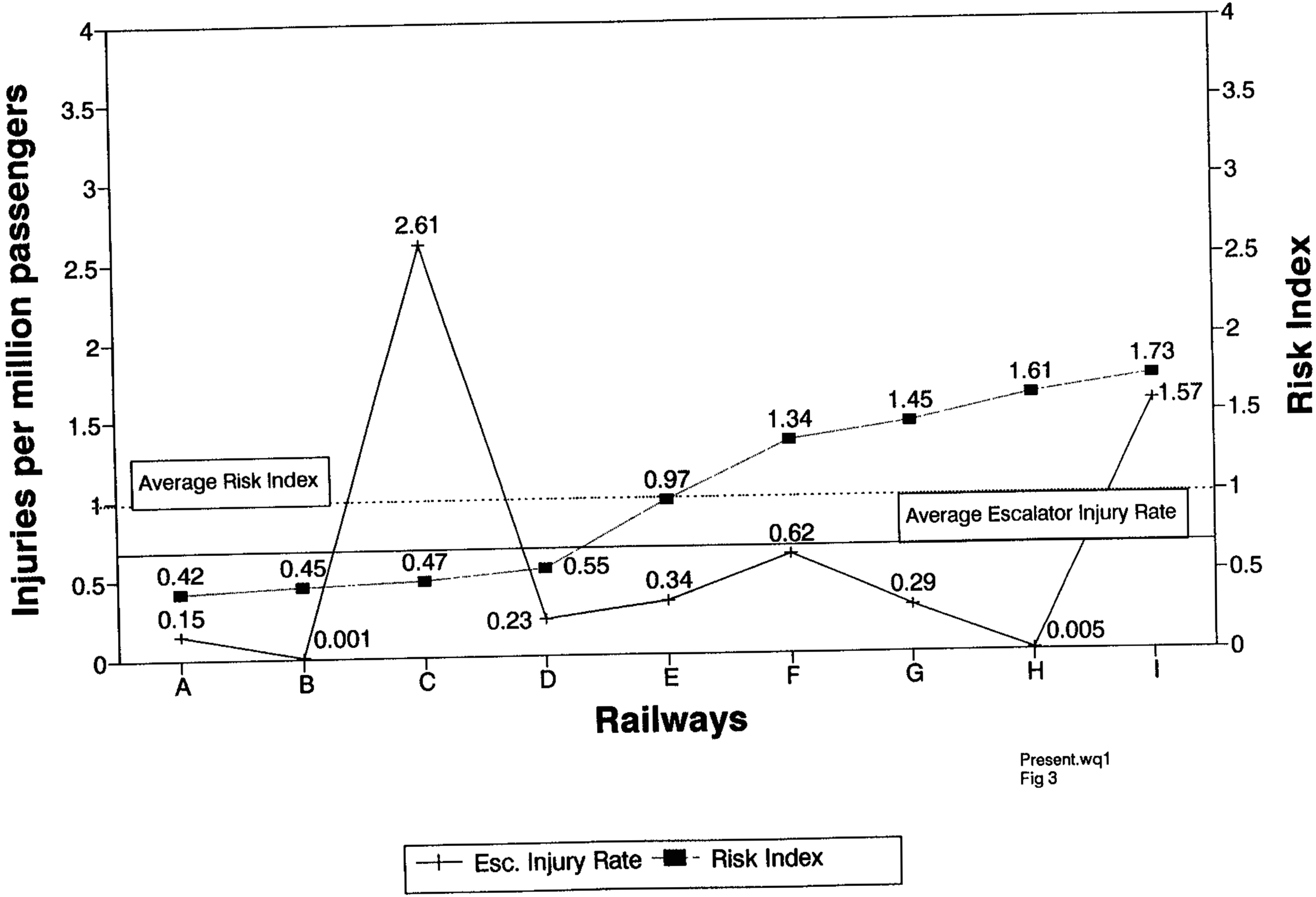
FIG 2: Speed and Number of Escalators vs Risk Index



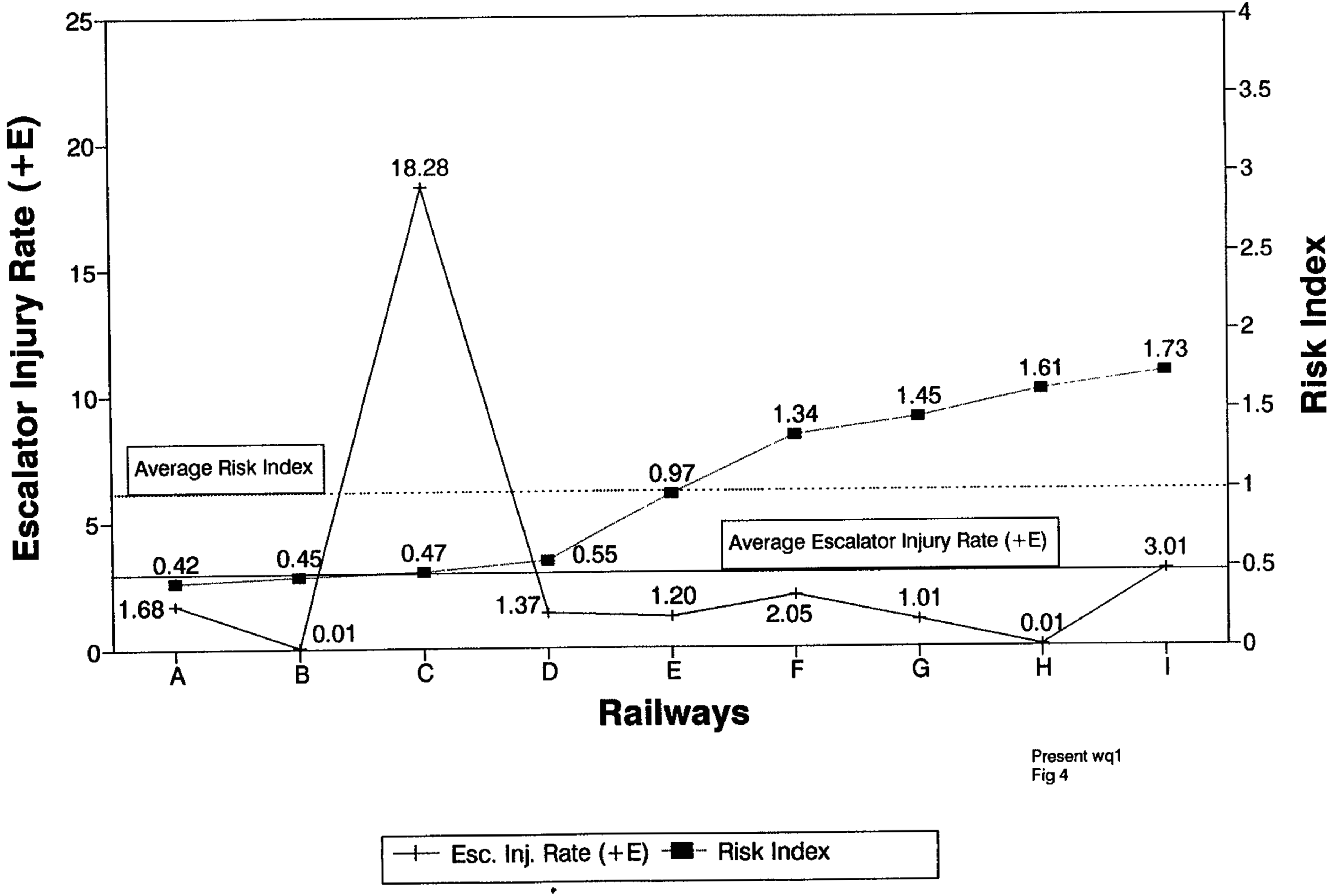
Present.wq1
Fig 2

FIG 3: Escalator Injury Rate vs Risk Index



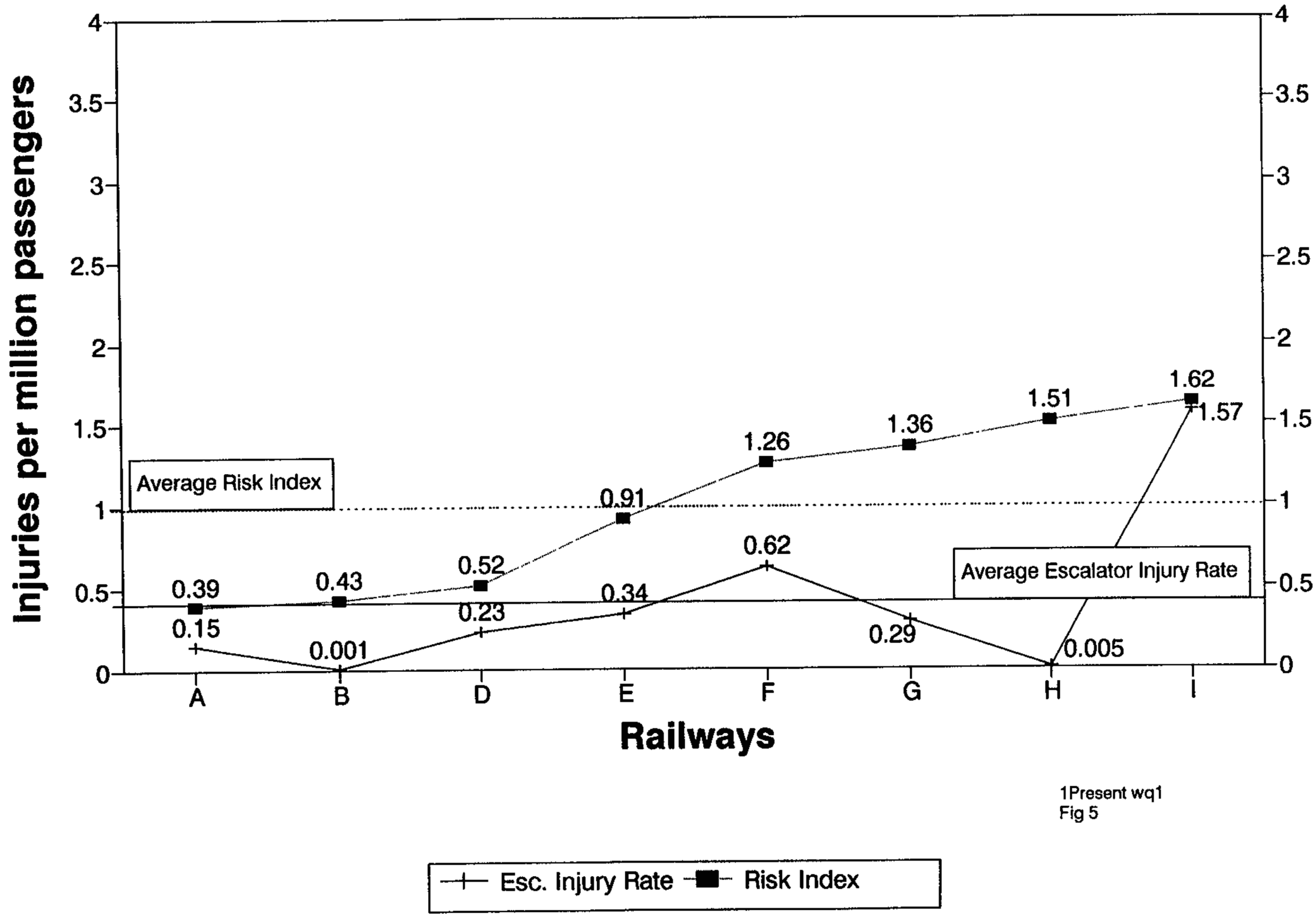
Present.wq1
Fig 3

FIG 4: Escalator Injury Rate (+E) vs Risk Index



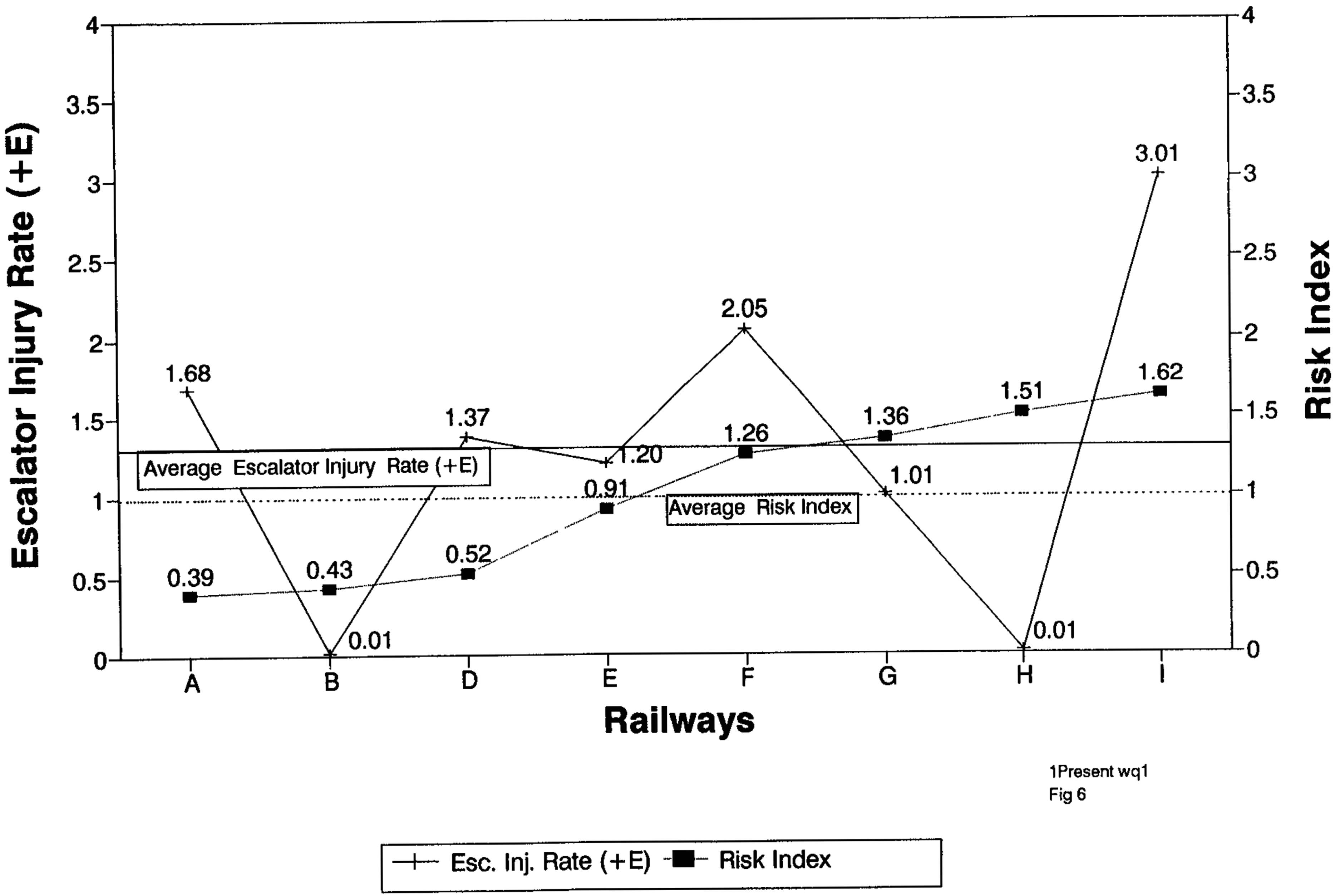
Present wq1
Fig 4

FIG 5: Escalator Injury Rate vs Risk Index



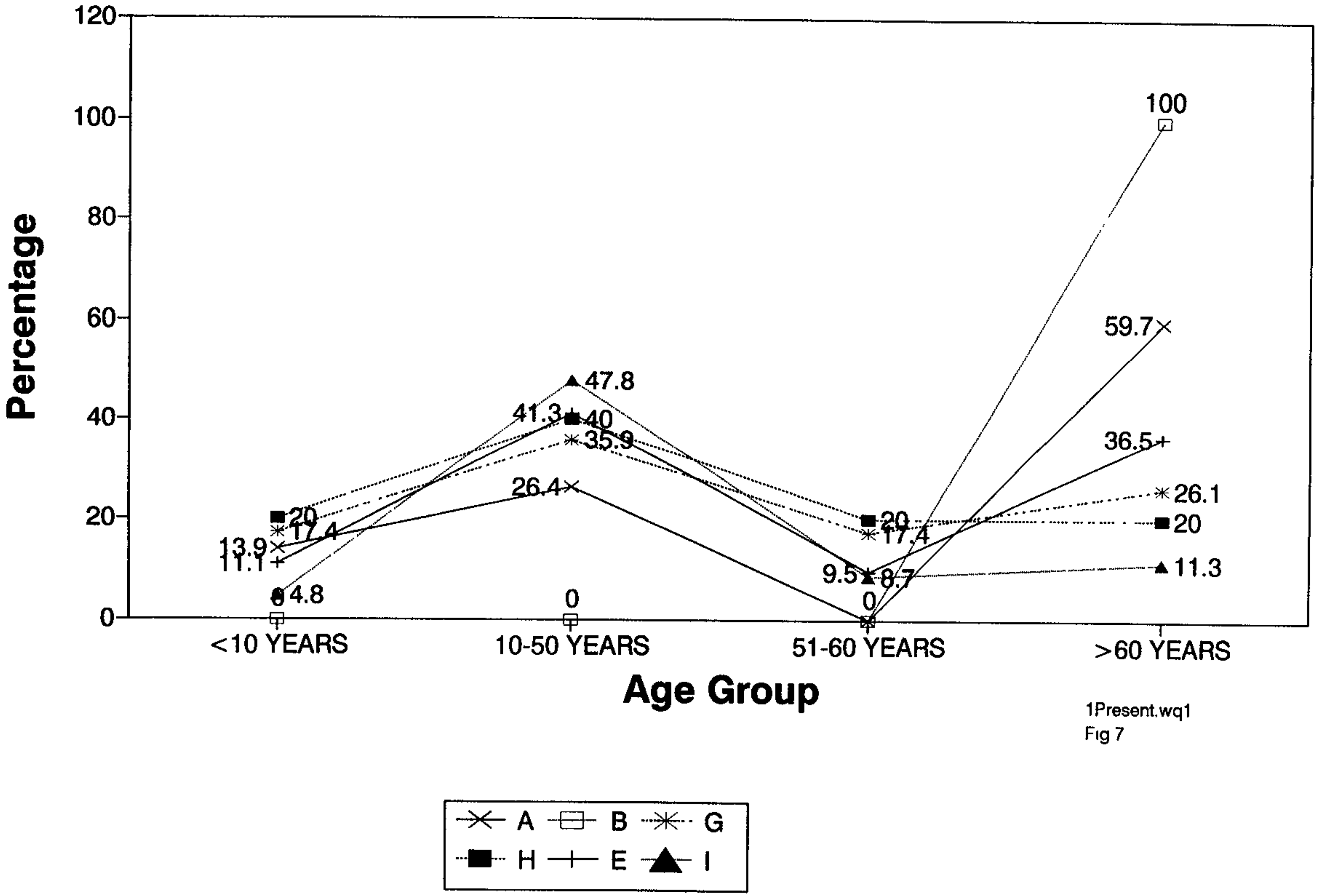
1Present wq1
Fig 5

FIG 6: Escalator Injury Rate (+E) vs Risk Index



1Present wq1
Fig 6

FIG7: Age Profile of Injured Passengers



1Present.wq1
Fig 7

Table 1 - Data from Escalator Injury Survey

Railways		A	B	C	D	E	F	G	H	I
Average daily trips (in millions)		1.4	3.89	0.12	3.7	0.474	2.15	0.86	5.7	0.508
Ridership for 1996 (in millions)		493.7	1423	43.6	1100	372	784	312	2080.5	146
Number of escalators vs operating speed	0.5 m/s	13	137	143	166	236	0	2	457	522
	0.6 (0.65) m/s	-	0	0	0	38	37 (88)	0	24	0
	0.75 m/s	75	0	0	0	8	169	290	0	0
	No record	-	-	-	-	-	8	-	-	-
Total number of escalators		88	137	143	166	276	302	292	481	522
Width of escalator step (in mm)		1000	1000	1000	600-1000	600-1000	1000	1000	800-1200	980
Passenger Injuries vs Escalator Running Speed	0.5 m/s	16	2	114	250	126	x 0.75 of overall pax injury rate	-	10	230
	0.6 m/s	-	-	-	-	-		-	0	-
	0.75 m/s	57	-	-	-	-		92	-	-
Passenger Injuries vs Age Groups	< 10 yrs	10	0	NA	NA	14	NA	16	2	11
	10 - 50 yrs	19	0	NA	NA	52	NA	33	4	110
	51 - 60 yrs	-	0	NA	NA	12	NA	16	2	20
	> 60 yrs	43	2	NA	NA	46	NA	24	2	26
	Unknown	-	NA	NA	NA	2	NA	3	NA	63
Overall passenger injury rate (injuries per million passenger)		0.30	0.001	0.382	2.27	0.34	0.82	0.59	0.001	1.57

Note : NA = Not Available

table1&2 wpd

Table 2 - Calculated Data

Railways		A	B	C	D	E	F	G	H	I
Overall passenger injury rate (injuries per million passengers)		0.30	0.001	0.382	2.27	0.34	0.82	0.59	0.001	1.57
Escalator passenger injury rate (injuries per million passengers) (calculated)		0.15	0.001	2.61	0.23	0.34	0.62	0.29	0.005	1.57
Injury rate (+E) (injuries per trillion passengers - esc)		1.68	0.01	18.28	1.37	1.2	2.05	1.01	0.01	3.01
Multiplying factor in relation to escalator speed	1 for 0.5 m/s	13	137	143	166	236	0	2	457	522
	1.2 for 0.6 m/s	0	0	0	0	45.6	150	0	28.8	0
	1.5 for 0.75 m/s	112.5	0	0	0	12	253.5	435	0	0
	Sub-total	125.5	137	143	166	293.6	403.5	437	485.8	522
Risk factor		4.63%	5.05%	5.27%	6.12%	10.82%	14.87%	16.11%	17.9%	19.24%
Risk index		0.42	0.45	0.47	0.55	0.97	1.34	1.45	1.61	1.73

International Rail Safety Conference

1997 LUCERNE

21 May - 23 May 1997
Swiss Transport Museum, Lucerne, Switzerland

Paper 9727

Mrs Daphne Mabale

Involving Trade Unions in SHE (Safety; Health; Environment) Principles of a SHE Forum

Publisher
2000 International Rail Safety Conference

Schweizerische Bundesbahnen
Chemin de fer fédéraux suisses
Ferrovie federali svizzere
Swiss Federal Railways

INTERNATIONAL RAILWAY SAFETY CONFERENCE (IRSC) 1997
21 to 23 May, Lucerne / Switzerland

PAPER:	**Risk Management** **Involving Trade Unions in SHE** **(Safety; Health; Environment)** **Prinicples of a SHE Forum**
PRESENTED BY:	**Mrs. Daphne Mabale** **Occupational Risk Consultant**
DATE:	**22.05.97**
SESSION:	**IX**
TIME:	**0900-0930**

CURRICULUM VITAE

DAPHNE MABALE

Daphne Mabale is presently an Occupational Risk Consultant at Spoornet in South Africa. She joined Spoornet on 3 July 1995.

Prior to joining Spoornet, Daphne was a Health Care Consultant with one of the leading firms of consultancy, Ernst & Young International. She was involved in health care projects with a client base that included, the SA Government, Private Sector Organisations and Non Governmental Organisations (NGOs).

Daphne has a wealth of experience in nursing from Baragwanath Hospital where she is well respected by the Nursing Fraternity. She has excelled both academically and as a leader. Her record includes history as first nurse in Baragwanath hospital to achieve a Diploma in Labour Relations and the first nurse at Baragwanath hospital to qualify a BA Cur degree majoring in Nursing Ethos and Professional Practice.

Her extensive involvement with Trade Unions started in her nursing career when she was elected as a chairman of a dispute resolution committee at Baragwanath hospital, during South Africa's historic hospital Health Worker's Strike that almost paralysed Public Health services.

In addition to a BA Cur degree, Daphne holds Diplomas, in General Nursing, Midwifery, Psychiatric Nursing, Labour Relations. She enjoys travelling and her overseas tours included places like London, France, Switzerland, Italy, Israel, Mauritius, etc. She is currently participating in a number of forums and has also appeared on SA television, two of local newspapers and took part in a radio talk show.

"INVOLVING TRADE UNIONS IN THE SAFETY; HEALTH; ENVIRONMENT (SHE) MANAGEMENT PROCESS - PRINCIPLES FOR A SHE FORUM"

1. INTRODUCTION

This paper describes the relationship between Management and Trade Unions in the work environment especially around safety, health and environment issues in South Africa.

It further outlines the process that was embarked upon by Spoornet Management and its Trade Unions to establish a co-operative structure of tackling safety, health and environment issues.

The quality of safety, health and environment standards and practices in the workplace is dependable on a number of factors that are influenced by the employer, employees, representatives of employees - Trade Unions and Government or legislation.

2. DEFINITION OF CONCEPTS

* A hazard is a potential to cause harm/injury.

* Safety is the absence of a hazard that may cause bodily injury.

* Danger means anything which may cause injury or damage to persons property, material or environment.

* Risk is the probability that a hazard will cause harm.

* Health is a complete state of physical, social and psychological well-being and not merely the absence of disease or infirmity.

* Occupational health and safety relates to health and safety in occupations or at work places.

You will realise ladies and gentlemen, that all these issues are related to hazards and risks in workplaces and how these hazards can be eliminated or better controlled.

The topic addresses emotive issues and is therefore politically sensitive. The decision on what is safe and healthy, which risks can be eliminated or terminated, transferred or tolerated at a working environment, automatically brings two parties i.e. Management and Trade Unions into a situation of conflict.

The reasons for establishing a SHE Forum cannot over emphasise the main objective of seeking continual restoration of the balance of power over these issues, so as to manage this inherent conflict.

3. SAFETY; HEALTH & ENVIRONMENT : LEGISLATION IN SOUTH AFRICA

South Africa, like many governments in other countries has passed laws that lay down what employers and employees should and should not do in the working environment.

These laws are based on the minimum standards that the government thinks that the poorest companies in various industries, can afford. Inspectors are employed by the government to enforce these laws. Unfortunately due to their shortage, these inspectors rely on the attitude of self regulation by the employers and therefore tend to be reactive in their intervention.

South Africa does not have an overall national strategy or policy on occupational safety, health or environment. The machinery governing SHE issues is often perceived as complicated because of being covered in many dıfferent pieces of legislation.

There's no uniform method of reporting occupational diseases and accidents and there are no statistics that reflect the full extent of the loss of life and health problems caused at the workplace.

3.1 SOUTH AFRICAN LAWS WHICH IMPACT ON OCCUPATIONAL SAFETY; HEALTH AND ENVIRONMENT.

- ***The Occupational Health & Safety Act No. 85 of 1993 (OHS Act No. 85 of 1993)***
  This law aims to make provision for the health and safety of employees and excludes mineral workers and workers on ships.

- ***Regulations of the OHS Act No. 85 of 1993***

- ***Hazardous Chemical Substances Regulations (HCS) of 1995***

  * Asbestos Regulations
  * Lead Regulations
  * General Safety Regulations
  * General Administrative Regulations

- ***Compensation for Occupational Injuries & Diseases Act No.130 of 1993 (COID Act 130 of 1993)***
  This law aims to provide compensation of disablement of workers who develop disease or injuries during the course of their employment.

- ***Environmental Conservation Act No. 73 of 1987***
  This law provides for the efficient protection and cotrolled utilization of the environment & several related subjects e.g. waste management, noise, vibration & shock.

- ***Atmospheric Pollution Prevention Act No.45 of 19556***
  This law provides for the prevention of air pollution.

- ***The Water Act No. 54 of 1956***
  This law provides for the prevention of water pollution.

- ***The Health Act No. 63 of 1977***
  This law provides for the protection of the public with little attention on occupational health.

The enforcement of safety, health & environment standards and the prevention of occupational accidents and diseases are located in different Government Departments i.e. the Department of Labour, National Health & Wellfare, Mineral & Energy Affairs, Agriculture and Environmental Affairs. Pollution matters are also dealt with by the Department of Water Affairs. Forces like the Defence, Police and Correctional Services have their own inspection divisions with regard to occupational health and safety.

- *The Labour Relations Act No. 66 of 1995 Section 84(5) states:*
  This Act has recently been promulgated in South Africa and it replaced the old Labour Relations Act No. 28 of 1956.

> ***"Subject to any applicable occupational health and safety legislation, a representative Trade Union and an employer may agree....***
>
> ***a) That the employer must consult with the workplace forum with a view to initiating, developing, promoting, monitoring and reviewing measures to ensure health and safety at work.***
>
> ***b) That a meeting between the workplace forum and the employer constitutes a meeting of a health and safety committee required to be established in the workplace by that legislation; and***
>
> ***c) That one or more members of the workplace forum are health and safety representatives for the purpose of that legislation."***

- ***Section 84(5) of the Labour Relations Act*** in short implies that Occupational Health, Safety is a matter of consultation with the workplace forum and therefore a matter unsuitable for collective bargaining.

- ***Section 85 of the Labour Relations Act*** further lays down the process of this consultation. Finally, should Management and the Trade Union fail to reach an agreement, they should use their agreed deadlock breaking or dispute resolution structures or procedures.

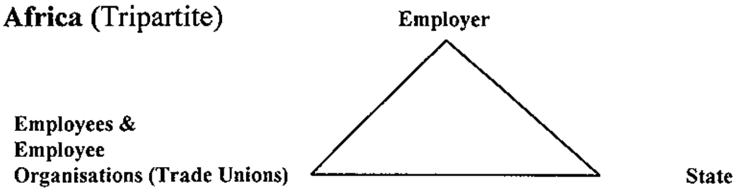
- ***The South African Constitution Section 29 of the Constitution Act No. 200 of 1993*** states:

> ***"Every person shall have the right to an environment which is not detrimental to his/her health or well- being."***

Given this background of complex regulation of safety, health and environment, it is encouraging to state that the South African government recognises that unless urgent measures are implemented to ease the country of these complexities, the existing laws regulating occupational safety, health and environment will not comply with the provisions in the Reconstruction and Development Programme (RDP). Different role players and stakeholders are currently engaged in setting up a co-ordinated corrective action plan.

3.2 A SAFE WORKING ENVIRONMENT WITHOUT RISKS TO HEALTH

Role players in South Africa (Tripartite)



3.3 CO-OPERATIVE STRUCTURES IN THE OHS ACT 85 OF 1993

- *Section 16 (1)* Imposes the duty on the Chief Executive Officer (CEO) as an employer to properly manage health and safety matters and ensure compliance to the law.

- *Section 16 (2)* The CEO may assign duties to a person under his control.

- *Section 17* Health & Safety Representatives.
  These are representatives of employees and are democratically elected by fellow workers to inspect the workplace and liase with Management.

- *Section 19* Health & Safety Committees.
  The committees are established where more than one Health & Safety Representative has been designated. The committee consults with the employer with an aim of initiating, developing, maintaining and reviewing measures aimed at protection of employees.

4. MANAGEMENT AND TRADE UNION RELATIONSHIP IN SPOORNET (SHE FORUM)

Transnet is South Africa's largest transport company specialising in business such as South African Airways (SAA), Spoornet, Metrorail, Portnet, PX, Autonet and Petronet.

Spoornet is the largest division of Transnet focusing on the transportation of freight. There are seven Trade Unions in Spoornet that have a recognition agreement with Management for employee representation.

Custodians of occupational health and safety and environment in Spoornet, are Risk Management Department and Human Resources Department. An integrated, co-ordinated SHE strategy is still in its infantile stages of development by these two departments.

The philosophy for SHE management in Spoornet is based on the Occupational Health & Safety Policy of Transnet that states: "Transnet considers its employees to be its most valuable asset and undertakes to protect them as far as reasonably practicable, from injury or damage to their health arising from any of the company's operations."

This statement has been the guiding principle to Spoornet for recognising and accepting that accidents and incidents at the workplace occur, not only due to the carelessness of employees but also due to failure in control within the organisation by Management i.e. Accidents and incidents are caused by absence of adequate management control. Management then initiated a process of establishing a co-operative structure with its seven Trade Unions, that would ensure interaction and joint consultation around SHE issues. This structure is called the SHE Forum.

The main aim of the structure is to create an effective forum with a common understanding of risks and how to control these risks in a co-operative effort. This forum was seen as strengthening the already existing structures set by the OHS Act of 1993.

The conceptualisation of such a structure in Spoornet took place over a period of time, long before the announcement or promulgation of South Africa's new Labour Relations Act (LRA) No.66 of 1995 regarding Workplace Forums. The SHE Forum should therefore not be confused with the Workplace Forums of the LRA, as the principles governing the two are different.

Spoornet SHE Forum was established purely based on the moral obligation of Spoornet to maximise legislative requirements governing SHE matters in the workplace. Provisions of how this SHE Forum function, are not regulated by any law. The responsibilities and relationship of the parties aim at promoting a positive SHE culture in the workplace.

The ethos of the guiding principles of this Forum is based on the following concepts:

a) Co-operation : participation, commitment, involvement and well-being of employees.

b) Communication : ability to listen, to hear and to understand.

c) Competence : education and training of employees about the hazards in their workplace. (Knowledge; attitudes; skills; etc.)

The following is the process that took place, towards the establishment of the SHE Forum in Spoornet.

Step 1 : South Africa highly sensitised about democracy and democratic principles.

Step 2 : South African Corporations affected and influenced by the evolution of democracy.

Step 3 : Spoornet recognises its role to democracy and the need to empower employees. Conceptualisation of transparent, consultative, co-operative methods are discussed by Spoornet Management

Step 4 : The new OHS Act 85 of 1993 is promulgated.

Step 5 : Spoornet Top Management mandates Risk Management to establish a SHE Forum (July 1995)

Step 6 Risk Management and Spoornet seven Trade Unions hold a two days Summit to create a charter for the SHE Forum. The parties agree on guiding principles of the charter. A working committee is elected between the two parties to formalise the charter.

Step 7 : The working committee finalises the charter. The parties agree on the procedure to present the charter to Spoornet Executive Management and to allow parties to sign the charter as a symbol and contract of agreement and commitment.

Step 8 . A signing ceremony takes place at Spoornet. The Chief Executive Officer (CEO) Spoornet and the Executive Director of Transnet, represent Spoornet Management. **(See insert articles).**

Step 9 : Working committees of the Forum are established at the first meeting. All systems roll and the Forum meets every two months in Spoornet.

5. CHARTER OF THE SPOORNET SHE FORUM

CHARTER FOR THE CREATION OF A SPOORNET SAFETY, HEALTH AND ENVIRONMENT (SHE) INTERNAL STAKEHOLDERS FORUM (SPOORNET SHE FORUM)

BACKGROUND

Management and the Trade Unions (The Parties) agree that a Spoornet national forum needs to be created to discuss matters of common interest related to safety, health and environment (SHE) issues

The main reasons are .

a) In Spoornet there is a need to discuss SHE policy and strategic issues at a higher level and on a national basis with Trade Unions, and to communicate these at all levels within Spoornet

b) A need to improve the knowledge and interpretation of Act 85 (and other applicable Acts) at a local (depot) level.

c) A need for a national agreement, including education on SHE matters.

d) Although this was a Spoornet initiative, there was consensus that there is a need for a Transnet Forum to consider SHE issues

e) Personnel at local and national level need training and measurements need to be put in place to assess the effectiveness of the training.

f) The need to find a way to democratise local structures i.e. to inform personnel on matters which directly affect them with regard to SHE.

g) In line with developments in the world and in this country that decision making is required to be more transparent, and that all involved are to be held accountable for their actions.

STRATEGIC INTENT

The Parties agree to the following statement of strategic intent against which the future strategies and actions of the SHE forum will be measured.

"The Parties are committed to the need for a continuous, effective, consensus seeking and focused communication forum on SHE policies, strategies and cultures at all levels within Spoornet, thereby establishing more effective implementation of SHE strategies, objectives and action plans, in support of the Spoornet Vision."

REPRESENTATION ON THE PROPOSED SPOORNET SHE FORUM

TRADE UNION

It is agreed that each of the seven Spoornet Unions would be represented by 1 member, with a nominated alternative

MANAGEMENT

Management will be represented by a representative from line control management viz. Infrastructure, Rolling Stock, Train Operating, Human Resources, Risk Management and Metro.

It is further agreed that the forum had the right to co-opt specialist and representatives of interest groups on an ad hoc basis.

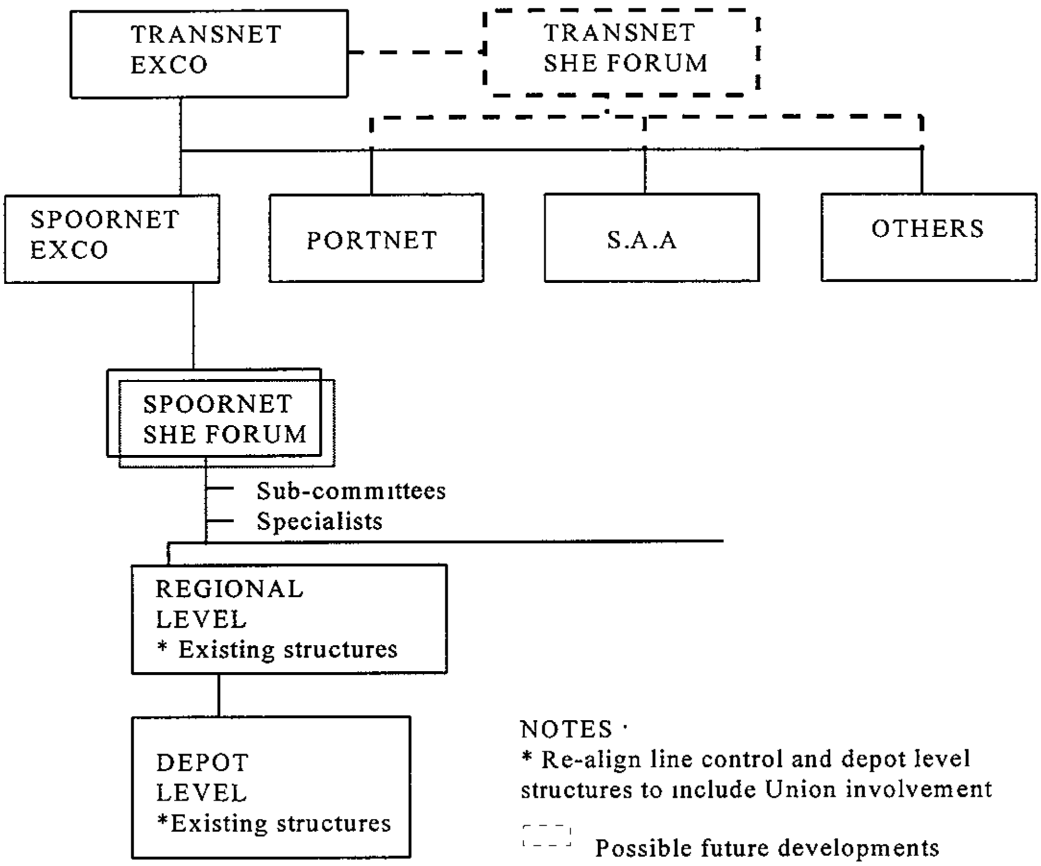
Transnet Risk Management could be represented on an ad hoc basis to assist in addressing particular matters.

ORGANISATIONAL STRUCTURE AND CONTEXT OF THE SPOORNET SHE FORUM

ORGANISATIONAL CONSIDERATIONS

- Management will provide the secretariat for the forum.
- The chairman will be appointed by the forum to serve for a 12 month period.
- The forum will meet quarterly.
- Sub-committees/specialists are to meet on an as-and-when necessary basis.
- The forums will have standard agenda items :
  - a) Safety
  - b) Health
  - c) Environment
  - d) Communication
  - e) Training
  - f) SHE performance and effectiveness measurements
  - g) Monitoring progress at national and regional levels
  - h) Information re compliance to statutory obligations
- Items for discussion to be provided 3 weeks before the next forum to facilitate proper co-ordination and research before the meeting.

The proposed structure is depicted on the diagram bellow



6. PRINCIPLES OF THE SHE FORUM

The following broad principles are agreed to by the Parties, which will give effect to and compliment the statement of strategic intent :

a) The forum will be **consultative**
b) The **parties are to be mandated** to make decisions
c) **Disputes and matters for negotiation to be referred** to the Spoornet Chamber of the Industrial Council
d) **Decisions** of the forum **will not be taken by voting,** but by consensus
e) **Failing consensus,** Spoornet management reserves the right to make and implement decisions, after the Trade Unions have been given an opportunity to meaningfully influence decisions
f) **Decisions** taken at the forum **can be referred** to sub-structures for implementation/execution

g) **Matters of strategic or of national operational importance** which may impact on existing SHE policies and procedures **will be discussed**. Local and line control operational matters are to be dealt with at that level.

h) **The forum** will play an **advisory role** to Transnet, Spoornet Top Management and Line Control SHE forums.

i) **Only SHE matters** related to Spoornet business processes, including Metro, **will be discussed**.

j) **The forum has the right to appoint sub-committees** to deal with specialised matters or projects

k) **Management and Unions** will display **transparency and accountability** in dealing with SHE issues.

7. CONCLUSION

South Africa with its inherent problems around employer and employee relationship, has a long way towards translation of the aspirations of the RDP into total reality.

SHE issues are part of these aspirations based on the understanding that workers; have a basic right to health and safety within the working environment. Spoornet recognises that improved performance and productivity cannot be measured by production and the quality of production only. The ratio of input and output to determine productivity must take into account the well-being of Spoornet employees as they are not consumables in producing the product

WORKERS life

SAFETY, HEALTH & ENVIRONMENT FOR YOU, THE WORKER

What's Inside?

November/December 1996 Vol. 2 No 7

Spoornet signs health and safety deal with unions

Spoornet has entered into a safety, health and environmental protection (SHE) agreement with its seven trade unions.

The agreement was signed recently at Spoornet headquarters in Paul Kruger Building in Johannesburg between the seven trade unions and management of Spoornet, which was represented by the chief executive Braam Le Roux and the executive director of Transnet, Mafika Mkhwanazi.

All seven trade unions were present at the signing ceremony, described by Le Roux as an important milestone in the history of the company.

The agreement paves the way for the formation of a Spoornet national forum that will deal with all SHE matters.

Le Roux, in his address before the signing ceremony, said there used to be more than 60 fatal accidents a year in the company in the apartheid years. That figure has been narrowed down to 20 serious but non-fatal accidents a year.

"Our challenge here today is to ensure that we all work together and co-operate, in the spirit of the new Labour Relations Act, to reduce this figure to zero," he said.

Echoing the words of Le Roux, Mkhwanazi said he hoped the agreement would be taken further to all other areas of mutual interest and to other Transnet divisions.

The Spoornet union and management team, from left to right: Nana Moabi of Blatu, chief executive Braam Le Roux, executive director of Transnet Mafika Mkhwanazi and Neels Haasbroek of WUSA.

Neels Haasbroek, vice-president of the Employees Union of South Africa, said the agreement was so important it should be implemented speedily "as we don't want any more delays".

"This is a milestone in the history of Spoornet. We hammered out an agreement and came to a signing ceremony with virtually no disagreements, conflicts and arguments. We have never had such a wonderful working relationship on both sides of the divide. If we can carry this spirit into the work of the forum, then Spoornet will be a shining example for all to emulate," he said.

Nana Moabi, of the Black Transnet Trade Union (Blatu), said the idea behind the creation of the forum was to make Spoornet accident-free. "This could only be achieved with co-operation of all stakeholders in the company and its employees."

A statement issued at the signing ceremony said it had been agreed by all parties that Spoornet needed such a forum to handle all SHE matters, including training and communication, and to democratise decision-making in the company.

The forum will be a consultative body mandated to make decisions on all SHE matters. Its decisions will be taken by consensus as opposed to voting.

The statement emphasised that the agreement does not take away the right of management to manage. If there is a dispute it will be referred to the Spoornet chamber of the Industrial Council. Management will still reserve the right to make and implement decisions on SHE matters but only after trade unions have been given an opportunity to meaningfully influence the decisions.

"All the parties are committed to the need for a continuous, effective, consensus-seeking and focused communication forum on SHE policies, strategies and cultures at all levels within Spoornet. This will also enable the establishment of a more effective implementation of SHE strategies, objectives and action plans in support of the Spoornet vision," the statement said.

International Rail Safety Conference

1997 LUCERNE

21 May - 23 May 1997
Swiss Transport Museum, Lucerne, Switzerland

Paper 9728

Bill Casley

Rail Safety Regulation Down Under

Publisher
2000 International Rail Safety Conference

Schweizerische Bundesbahnen
Chemin de fer fédéraux suisses
Ferrovie federali svizzere
Swiss Federal Railways

INTERNATIONAL RAILWAY SAFETY CONFERENCE (IRSC) 1997
21 to 23 May, Lucerne / Switzerland

PAPER: Safety Regulations
Rail Safety Regulation Down Under

PRESENTED BY: Mr. Bill Casley
Executive Director Transport Safety Bureau

DATE: 23.05.97

SESSION: IX

TIME: 1000-1030

WILLIAM CASLEY - BIOGRAPHY

Bill Casley has been involved with the Australian railway industry since 1952 Whilst he commenced his career as an apprentice in 1952, he has been actively involved in a range of senior management positions including that of Chief Mechanical Engineer in the NSW State Rail Authority

In 1992 he was 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. The development of this new legislation represented a significant personal challenge as little precedent existed within Australia for the independent regulation of railways either on a statewide or a national basis. The proclamation of the NSW Rail Safety Act in September 1993 established a significant landmark in the operation of railways in NSW and has served as a national benchmark for similar legislation throughout Australia.

Since then he has worked continuously in the area of transport safety and is currently heading up the Transport Safety Bureau of the NSW Department of Transport. In this role he is responsible for enhancing the safety of all public transport modes operating in NSW, including rail, bus, coach, ferry and taxis.

INTERNATIONAL SAFETY CONFERENCE

LUCERNE, 1997

RAIL SAFETY REGULATION DOWN UNDER

AN

OVERVIEW OF RECENT ACHIEVEMENTS

IN

RAILWAY SAFETY REGULATION

WITHIN

AUSTRALIA

W.S.Casley

Executive Director

NSW Transport Safety Bureau

1. INTRODUCTION

When the Stockton to Darlington Railway was opened in the United Kingdom, on 25 September 1825, it was the world's first public railway. Australia, at that time, consisted of six Colonies each having its own governments and legislature. The administrators of these colonies recognised the ability of railways to provide effective and economic means for transportation in the vast outback of the colonies. Throughout the colonies much discussion and negotiations were undertaken to establish the means whereby each could introduce the new technology into their colony. As early as 1848 men and women of vision recognised the need for consistency in regards to the size of the railway gauge to be adopted by the colonies, the standard gauge of 4' 8½" being widely expressed as the most desirable gauge for future Australian railways.

In 1851 the New South Wales government, on the premise that it would provide better ride stability and improved track wear characteristics than that considered achievable by the standard gauge of 4' 8½", advised the South Australian and Victorian governments of its decision to construct its railway to the Irish gauge of 5' 3". Accordingly the South Australian and Victorian governments proceeded to order rolling stock for their new railways. However, by 1853 New South Wales again changed its mind having become convinced that the wider gauge would not realise the original expectations. It again advised the Southern Colonies of its decision and was somewhat dismayed at their reluctance to follow New South Wales. The orders for the South Australian and Victorian rolling stock to 5' 3" had been finalised and the scene was set for a multiplicity of railway gauges which have plagued the rail industry in Australia ever since. Queensland, Western Australia and Tasmania for economic purposes decided to build their respective railways to the narrow gauge of 3' 6".

In May 1854 South Australia opened the first recognised railway in Australia, albeit a horse drawn railway. Later in September that year Victoria commenced its operations of the "Hobson's Bay Railway". The New South Wales railway followed one year later in September 1855. It was not until 1962 that it was possible to traverse across the continent, through each of the mainland States, by means of a standard gauge railway.

Today railways throughout Australia operate over 38,194 kilometres of track, carrying annually some 325 million tonnes of freight and 428 million passengers on a range of gauges, namely:

Broad gauge	5' 3"	(1600mm)	5,333 kilometres
Standard gauge	4' 8½"	(1435mm)	17,301 kilometres
Narrow gauge	3' 6"	(1067mm)	15,560 kilometres

2. HARMONISATION OF RAIL SAFETY STANDARDS

The need for harmonisation of rail safety standards was recognised in 1993 and prompted an investigation into a national approach to rail safety regulation arrangements. Prominent amongst the issues facing the industry at this time was the growing prominence of interstate rail operations and the opening up of the government owned rail infrastructure to third party operators who were entering the rail industry as new players.

Following extensive discussions and review the Australian Commonwealth, State and Territory, Ministers for Transport agreed that as from 1 July 1996 an Intergovernmental Agreement (IGA) would come into force to provide for a national approach to rail safety accreditation.

3. INTERGOVERNMENTAL AGREEMENT

The Australian intergovernmental agreement (IGA) has been established as a cost effective nationally consistent approach to the regulation of rail safety independent of railway owners and operators. The Agreement ensures there is no barrier to the entry of third party operators, and is based on:

- safety accreditation of railway owners and operators,
- mutual recognition of accreditation between accreditation authorities,
- development and implementation of performance based standards,

- greater accountability and transparency,
- facilitating competition and technical and commercial innovation consistent with safe practice.

The IGA provides that where a railway functions in one or more jurisdictions, its accreditation in one jurisdiction will be mutually recognised by other jurisdictions. In practice, the various rail regulators in Australia have opted for a system whereby one jurisdiction will act as a broker to facilitate the application of mutual recognition. The aim here is to minimise the number of parties that a particular railway must deal with to obtain accreditation. A mutual recognition facility can be exercised between relevant parties to the IGA. The mutual recognition provisions are based on an effective assessment and determination by the facilitating jurisdiction of the application for accreditation in accordance with the criteria contained in the Australian Standard for railway safety management, AS 4292.

It is a condition of participating in the IGA that each jurisdiction shall have in place legislation or appropriate administrative action which allows for the application of the Australian Standard for railway safety management together with any additional requirements specified by the jurisdiction as the basis for accrediting safe operations by interstate railway owners or operators. The need for additional requirements in different states arises from their vastly different geographic condition.

The relevant participating jurisdiction's legislation or administrative actions are:

Legislation

New South Wales	Rail Safety Act 1993
Queensland	Transport Infrastructure Amendment (Rail) Act 1995
South Australia	Rail Safety Act 1996
Victoria	Transport (Rail Safety) Act 1996

Administrative action

Western Australia	The Government Railways Act 1904

4. AUSTRALIAN STANDARD - RAILWAY SAFETY MANAGEMENT - AS 4292

In common with all responsible industry, the railway industry's safety objective is to minimise the risk of harm to people and damage to property. Accordingly, the Australian Standard, AS 4292, was prepared by the Standards Australia Committee on Railway Safety in response to a request by the Railway of Australia Committee. Support came from railway regulators, to prepare a uniform set of safety standards to simplify the development of safety management systems. The Standards are also intended to facilitate interfacing of owners and operators on any railway, and to facilitate the safety accreditation of railway industry participants.

The Standard deals with the requirements of a railway safety management system and consists of the following series of Standards:

Part 1:	General and interstate requirements
Part 2:	Track, civil and electric traction infrastructure
Part 3:	Rolling stock
Part 4:	Signalling and telecommunications systems and equipment
Part 5:	Operational systems
Part 6:	Railway interface with other infrastructure

The Standards have been prepared primarily with a view to achieving uniformity in the management of railway safety.

5. SAFETY ACCREDITATION OF RAILWAY OWNERS AND OPERATORS

It is the applicant's responsibility to ensure that sufficient information is submitted to enable an effective assessment and determination of the accreditation application. Generally, applicants must demonstrate that the specified railway can be operated at an appropriate level of safety performance commensurate with the interface of the railway's activities with other users. In particular the applicant needs to demonstrate a competency and capacity to meet standards for the purpose of the safe operation of the specified railway relating to:

- Financial viability;
- managerial and technology competency;
- suitability of rolling stock;
- appropriateness of safeworking systems;
- availability and competency of railway employees
- availability and adequacy of the infrastructure and other relevant facilities;
- public risk insurance.

6. NATIONAL GUIDELINES FOR ACCREDITATION

A significant outcome of the signing of the Intergovernmental agreement has been the establishment of national guidelines for rail safety accreditation applications. The guidelines are intended to be read in conjunction with the Australian Standard on railway safety management, AS 4292 and provide a clear indication of the scope and detail for the documentation necessary to support the application.

Before submitting an application for accreditation, applicants are actively encouraged to discuss their proposals with the facilitating agency prior to the formal lodgement of the application. Generally the accreditation process requires a number of meetings, depending on the scope of the proposal. This arrangement enables the applicant to obtain a clear understanding of the requirements for accreditation and for the agency to ascertain the scope of the applicant's accreditation proposal.

Where an application involves interstate operations it is important that the applicant has a clear understanding of the scope of activities in each of the relevant jurisdictions.

It is mandatory that applicants for accreditation have a comprehensive understanding of the significant potential risks associated with the proposed railway activities and be able to clearly delineate how it is proposed to eliminate or control these risks.

Whilst the guidelines provide the criteria for all applications for rail safety accreditation by railway owners and/or operators, the rail safety accreditation agencies have also developed Notes of Administration to ensure that relevant agencies apply consistent criteria when determining the acceptability of an applicant for accreditation

7. INVESTIGATIONS

The IGA provides an opportunity for accredited persons to seek the appointment of an independent investigator to investigate an accident or other serious incident involving interstate rail operations in which death or major damage occurs.

However, the final decision as to whether an independent investigator is appointed lies with the responsible rail investigation body of the jurisdiction in which the accident or incident occurred. Generally the appointment of an independent investigator is agreed between the parties involved. However, where such agreement cannot be reached, the investigator shall be appointed by the relevant rail investigation body in the jurisdiction where the accident or incident has occurred. A national panel of investigators has been established and is composed of a number of experienced rail investigators nominated by each party to the agreement.

In New South Wales the Rail Safety Act prescribes that accredited owners and operators must inquire into any railway accident or incident that may affect the safe construction, operation or maintenance of the specified railway. In this regard the inquiries are to be conducted in an approved manner, to specified terms of reference and completion times. When completed the reports are independently reviewed by the NSW Transport Safety Bureau, which also monitors the implementation of any remedial action recommended in a report.

Once it is determined there is a requirement to establish an investigation panel, interested parties (accredited owners or operators) may submit items for consideration to be included in the 'Terms of Reference'.

In NSW the terms of reference for an inquiry shall be approved by the Director-General of the NSW Department of Transport or his nominee and will list the matters to be dealt with. This is a recent innovation and was adopted to avoid potential conflicts between competing railways which may be involved in an incident.

The terms of reference shall contain, but be not limited to the following:

- Establish the facts and sequence of events of the accident or incident
- Determine the cause of the accident or incident
- Specify any other matters that require clarification
- Identify any failures to perform responsibilities or obligations

Generally, where joint inquiries are to be conducted into an accident or incident the Owner of the Railway shall promptly initiate draft terms of reference and forward this draft to the Operator. The Operator shall in turn review the draft and provide comment to the Director-General without delay. Upon receipt of the draft the Director-General will adjudicate on any difference in views and confirm the terms of reference which are then forwarded to the parties to enable a prompt commencement of the inquiry.

The members of an investigation panel established under the provisions of the Rail Safety Act, are authorised officers under the same Act. As an authorised officer, the provisions of Division 1, Part 4 of the Rail Safety Act, will apply. These provisions grant authorised officers:

- The power of entry
- Powers with respect to investigation and inspections

- Powers in relation to relevant documents provided to an authorised officer
- Protection from self incrimination for individuals providing information to the investigation.

8. CODE OF CONDUCT - INVESTIGATION PANELS

Guidelines for Investigation Panels have been developed to assist officers with respect to their responsibilities, obligations and behaviour in the performance of their duties, and to promote efficiency, fairness and integrity. It is recognised that an officer may be required to conduct investigations of railways or organisations whereby a conflict may exist between the office's personal and professional interests. A conflict of interest arises where any of the following situations occur which may affect independence of the investigating officer:

- Organisational associations and affiliations.
- Financial interests.
- Personal relationships including family, friends, and relatives' associations.
- Outside paid and voluntary employment.

In New South Wales it is recognised that it is almost inevitable that a potential conflict of interest may exist for any officer employed within the NSW Transport Safety Bureau, due to the fact that officers with the necessary expertise and competency to perform such duties will have previously gained considerable experience with the Australian transport industry. As such they may be called upon to conduct investigations or inspections into incidents involving their previous employer.

In general, provided that officers adopt a professional, and objective approach in such circumstances, they should be capable of discharging their duties without compromising an acceptable degree of independence. Officers are required to exercise discretion and professional care in performing their duties.

An authorised officer under the NSW Rail Safety Act, is responsible for his/her actions and omissions. It is important that sufficient documentation is maintained to support decisions made and conclusions derived. Additional information detailing reasoning and/or approvals which support any deviations from prescribed procedures should also be kept.

The provisions of the NSW Rail Safety Act 1993, enables authorised officers to request, obtain, and access a multitude of confidential information such as:

- Financial information concerning the viability of railways and public transport operators.
- Conditions of accreditation.
- Information systems containing incident data ie. Rail Safety System and Passenger Transport Database.

It is imperative that this information is not disclosed to unauthorised sources or used to obtain personal gain from the disclosure of such information.

9. INFORMATION EXCHANGE

The Parties to the Intergovernmental agreement have established a joint information exchange arrangement which provides for high level incident data to be centrally collated and maintained. All states will provide monthly incident data to the centralised body, which will then collate the data to determine national safety performance trends, based on appropriate normalising factors. The aim of this database is to provide rail regulations with a useful information system which can assist in informed decision making. It will also facilitate detailed sharing of information between jurisdictions where a comparative analysis reveals that the railways in one jurisdiction are experiencing higher rates of incidents than another jurisdiction.

10. ALCOHOL AND OTHER DRUGS

It is a condition of accreditation under the NSW Rail Safety Act that railway owners or operators must ensure that all railway employees employed or contracted by them to conduct railway safety work are not under the influence of alcohol or other drugs when about to carry out, or while carrying out railway safety work.

Schedule 2 of the Act provides the mechanism within NSW whereby railway safety workers may be tested for the influence of alcohol or other drugs. The Act provides that it is an offence for a person carrying out railway safety work to:

(i) to have the prescribed concentration of alcohol present in the employee's blood.

(ii) to be under the influence of alcohol or any other drug.

The maximum penalty applicable to each of these offences is a fine of AUD$1,000 or imprisonment of 6 months, or both.

Testing of railway employees in NSW for the presence of alcohol has demonstrated that a satisfactory level of compliance is being achieved by railways in relation to their staff not being under the influence of alcohol. During the 24 month period ended 30 June 1996, 56 positive results were detected from 17,857 individual tests (approximately 3 positive results per 1000 tests). A significant proportion of these results were detected at the signing-on point and did not involve the person being involved in actually conducting railway safety work.

Period	Number of Tests conducted	Total Positive results	Positive rate per 1000 tests	Total staff	% Positive rate vs total staff
1994/95	8121	24	2.96	20186	0.12 x 1%
1995/96	9836	32	3.25	19742	0 16 x 1%
Total	17957	56	3.12	-	-

The future trend to out-source railway maintenance and safety work will place a greater responsibility on accredited railway persons to ensure staff employed or contracted for this work are aware of and comply with the requirements regarding alcohol and drug abuse.

11. MAJOR ACCREDITATION ACHIEVEMENTS IN NSW

The following describes some of the recent major railway projects in NSW for which accreditations which have been granted.

New Southern Railway

The New Southern Railway (NSR) is a unique private sector, public sector ownership arrangement and is Sydney's largest single transport infrastructure project in the lead up to the Year 2000 Olympics. It is a 10 kilometre long underground railway linking the East Hills line into the CityRail network via Sydney Airport and includes five stations.

It is an extraordinary complex, world class project using a wide range of engineering skills relating to hard and soft ground tunnelling, cut and cover tunnelling, underground civil structures, as well as electrical and mechanical services.

Significant progress has already been made on the tunnelling and station structures and the project is on track for completion in mid 2000.

Ultimo-Pyrmont Light Rail Project

The Ultimo-Pyrmont light rail project (UPLR) is a light rail system designed as a central feature of a plan for urban renewal of the Pyrmont precinct and will commence operations in July 1997.

Phase 1 of the project involves 3.6 kilometres of city street and a dedicated track corridor (reclaimed from former heavy rail tracks), linking the Central Railway Station with Sydney Casino, Chinatown, Darling Harbour and Pyrmont. The system has been designed to be fully accessible for disabled persons.

The street running sections have been constructed of fully welded rails embedded in a rubberised grouting, whilst the dedicated tracks laid on the route of an old railway line are welded rails on ballasted concrete sleepers. The system is powered by an 750V DC supply overhead cantenary system, suspended approximately 5.5 metres above the ground. Particular attention has been given to minimising noise and vibration, particularly where the light rail passes through sensitive areas such as the Capitol Theatre and the Lyric Theatre.

The vehicles for the UPLR are air-conditioned articulated trams based on modern European design adapted for Australian conditions. Each vehicle is designed for rapid and easy access and has a 100% low-floor arrangement. The vehicle is 29 metres in length, 2.65 m wide and weighs approximately 36 tonnes in the tare condition. The maximum speed of the vehicle is 80 kph and is capable of traversing 20 metre radius curves.

International Rail Safety Conference

1997 LUCERNE

21 May - 23 May 1997
Swiss Transport Museum, Lucerne, Switzerland

Paper 9729

Ulf Palsson

Harmonisation of Traffic Safety Rules in Scandinavia - Possibilities and Difficulties

Publisher
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Schweizerische Bundesbahnen
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INTERNATIONAL RAILWAY SAFETY CONFERENCE (IRSC) 1997
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PAPER:	**Safety Regulations** **Harmonisation of Traffic Safety Rules in Scandinavia**
PRESENTED BY:	**Mr. U. Pålsson** **Joint Director**
DATE:	**23.05.97**
SESSION:	**IX**
TIME:	**0930-1000**

International Railway Safety Conference, Luzern

Friday 23 May 1997

Harmonization of Traffic Safety Rules in Scandinavia -- Possibilities and Difficulties

by

Ulf Pålsson

Joint Director, Department of Safety

Swedish State Railways

CURRICULUM VITAE

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1971	General science degree
Previous positions	
1975 - 1977	Stockholm Transport Railway Signalman, traffic controller
1977 - 1982	Stockholm Transport Railway Production planning
1982 - 1988	Swedish State Railways, Department of Traffic Safety General matters related with safety of operations
1988 - 1992	Swedish Railway Inspectorate Rules and regulations
Current position	
1992 -	Swedish State Railways, Department of Traffic Safety Joint Director, responsible for traffic safety rules
Special assignments	
1990 - 1991	AT Signal System Work with ATP-systems in Sweden and Australia
1992	ERRI A200, within the ETCS Project Inquiry among European railways about traffic safety rules

Synopsis

Expansion of cross border rail traffic between the Scandinavian countries of Sweden, Norway and Denmark, both recent and in the near future, has prompted the need for harmonizing the railway traffic safety rules

Some work has started but so far only little progress has been made There are many obstacles to overcome However, in the very long term, we hope to get a common set of traffic safety rules

This paper describes some thoughts about the background and some of the difficulties

Scandinavian background

Cross border railway traffic

Until now, cross border traffic with through trains has been of a comparatively small extent, at least seen from a European continental point of view There are few cross border points

- between the Scandinavian countries

* Sweden - Norway	4	
* Denmark - Sweden	0	(+ 2 train ferry links)
* Denmark - Norway	0	

- to countries outside Scandinavia

* Sweden - Finland	0	(+ 1 with change of track gauge + 1 train ferry link)
* Denmark - Germany	1	(+ 1 with little traffic + 1 train ferry link)

Sweden and Norway use the same type of electrification, 15kV AC, 16 2/3 Hz Consequently motive power has been running through across the border since long ago

However, until a few years ago, change of train crew took place at a station, located only a few kilometres from the border

Close language relations

Swedish, Danish and Norwegian
* belong to the same branch of Germanic languages
* are close and mutually understandable to most Scandinavian people, at least written language Also spoken language will easily be understood by an experienced listener (although spoken Danish often causes trouble to many Swedes)

Political and historical ties:

For centuries, the kings of Denmark and Sweden fought many wars against each other The last ended however in 1809

Norway has strong ties to both its neighbours It
* was part of the kingdom of Denmark until 1814
* was united with Sweden 1814 - 1905 (one king in common but separate parliaments and governments)
* is independent since 1905

Common cultural background

A strong political movement called 'Skandinavism' started in the 19th century and eventually lead to the creation of the Nordic Council in the 1950 s (where also Finland and Iceland participate)

Since 1954, no passport is required for travelling to another Nordic country There is a common feeling of "belonging together" among the Nordic peoples

The Nordic governments have tried to harmonize many aspects of society, (legislation, social security rules,) and have to a large extent also succeeded in doing so (Unfortunately not the railway Traffic Safety Rules, so far!)

Traffic Safety Rules -- similarities and differences

In spite of all co-operation among the Scandinavian countries, the railway Traffic Safety Rules of each country were developed very much independently from the neighbours

However, there are many basic *similarities*

Influence from the continental (German) traffic philosophy, which has lead to
* dividing of the railways into 'stations' (junctions, crossing places,) and the 'open line'
* strict classifying into different types of movements 'train movements' and 'shunting movements'
* basically same philosophy about how to handle train movements at stations and on the open line, as well as shunting movements at stations

Nevertheless, looking more into detail we find many important and troublesome *differences* (among others)

* signal aspects from fixed signals
* hand signals
* procedures for passing fixed signals at 'stop' ('danger')
* rules for composition of trains (length, speed, braking)

Main reasons for harmonizing the rules

Two immediate reasons

1 Through running of train crews between Sweden and Norway

This began to a limited extent in 1993, with trains between Gothenburg and Oslo and between Kiruna and Narvik.

So far, a few Norwegian drivers are taught the Swedish rules to be able to drive in Sweden. When driving in Sweden, they are considered to be employed by the Swedish State Railways (SJ) Vice versa applies for their Swedish colleagues when driving trains for the Norwegian State Railways (NSB) in Norway

2 The new Öresund fixed link between Denmark (Copenhagen) and Sweden (Malmo), due to open in 2001

Heavy regional rail traffic is foreseen between the two densely populated areas, as well as some long distance passenger trains and freight trains

Here another solution then the one adopted for the Sweden-Norway traffic is considered necessary SJ will be Traffic Operator in both Sweden and Denmark, i e take full responsibility for staff and rolling stock also when running trains in Denmark The Danish State Railways (DSB) will similarly be Traffic Operator also in Sweden

This means that a lot of Swedish train personnel will have to learn the Danish rules and vice versa

It goes without saying that a lot of effort, time and money would be saved if the Traffic Safety Rules were the same, or at least more similar

Other reasons

The EU directive 96/48/EG about interoperability This concerns so far only high speed lines but will presumably be extended to cover other international lines also

Start of serious discussions

The safety directors of the railways in Scandinavia and Finland have met regularly since the 1970 s Now and then harmonization matters have been discussed, but it was not until 1995 that serious discussions began A preliminary list was set up of areas desirable to harmonize

- Normal train running and shunting
* brake test
* distribution of tasks and responsibility between driver and conductor
* procedure for starting trains (departure signal etc)
* requirements regarding use of ATC/ATP
* hand signals

- Traffic irregularities
* passing fixed signals at 'stop' ('danger') conditions, type of permission, vocabulary
* conditions for running without ATC/ATP

- Infrastructure
* functional requirements for interlockings, ATC/ATP, radio connections
* positioning, aspects and meaning of fixed signals and boards (signs)

- Instructions
* publications, such as working time table, descriptions of the lines
* printed forms for messages
* language, need for standardized wordings

Signalling engineers had already started to deal with the signalling matters It was considered necessary to get also traffic people involved in the process, and a work group of three was appointed to make a first survey of the current situation in Sweden, Norway and Denmark and to find answers to the following questions

* What basic traffic safety principles govern the rail traffic?

* What areas are most important to harmonize?

* What areas are comparatively easy to harmonize? What areas are difficult?

* What language should be used for cross border traffic?

Harmonization, on whose behalf?

The work group was formed of people from SJ, NSB and DSB, who all at that time were responsible for both Traffic Control and Traffic Operation Since then, organizational changes have taken place These changes have transferred some of the over all responsibility for harmonization

In Sweden, Traffic Control has been transferred from SJ to the National Rail Administration (Banverket, BV) In Norway and Denmark, National Rail Administrations have been created (Norway Jernbaneverket, JBV, Denmark Banestyrelsen, BS), these are in charge, as is the case in Sweden, of Infrastructure and Traffic Control

As a result, now the Swedish member of the work group is employed by the Traffic Operator SJ, while the two others are employed by the National Rail Administrations JBV and BS This has of course prompted the question of on whose commission the work shall be done

A Traffic Operator is mainly interested in reducing his cost in a short term, without increasing the risk levels He is not very interested in investing big money into, for example, education and training because of changing basic rules and principles that affect also other staff than the one used for cross border traffic The National Rail Administrations, on the other hand, tend more to be interested in harmonizing rules and principles in the long term

These different points of view affect the work However, the work group has, as a compromise, started to concentrate on a few questions, both "short term" and "long term"

* Basic Principles
* Composition of trains, speed, braking
* Procedure for starting trains (departure signal)
* Hand signals

Basic Principles

These contain the basic concepts which are "obvious" to every Scandinavian railway traffic employee

* Definitions station, open line, block section, train, shunting, signalman, driver, conductor,

* Principles block system running for train movements, on sight running for shunting movements, responsibilities and supervision by the signalman,

In Sweden, the basic principles have never been properly documented A draft was produced some years ago but has not yet been confirmed This draft is now being considered by the work group for possible approval also in Norway and Denmark, possibly with adjustments

Procedure for starting trains (departure signal)

This is the one area that the three countries almost have managed to harmonize The Danish principle of handling this has now been adopted in Sweden and Norway Its components

1 The driver gets permission to start from the signalman (by cleared fixed signal *or* by verbal permission to pass fixed signal at 'stop' *or* by hand signal)

2 The driver signals to the conductor that he has got the signalman's permission and that he is ready to start

3 The conductor checks that the station work (getting off and on, *loading/unloading*) is *ready Not until* he gets the "I am ready to start"-signal from the driver, he gives his departure signal

It remains however to harmonize the hand signals used, both how they are given and their names

Hand signals

It seems a very complicated matter to harmonize the hand signals If we take the hand signal 'stop' ('danger') as one example

Everyone agrees that it is important that the signal 'stop' is given in the same way Everyone also hesitates about how to force this through The meaning of one hand signal can of course not be changed from one day to another, doing so would involve unacceptable hazards

Let us assume that the Norwegian day time signal 'stop' is chosen (stretching out both arms) The same means 'Move forwards' in Sweden Then

1 a new 'Move forwards'-signal must be introduced in Sweden, a signal which ought to be the same as the one in at least one of the two other countries and which must not be the same as any other Swedish hand signal,

2 the "stretching out both arms"-signal must be in quarantine for a suitable period of time (one year?), after which

3 *the Norwegian type hand signal* 'stop' can be introduced in Sweden

To many people, these measures would seem far too complicated and costly Particularly one can assume that those who never or seldom get in touch with cross border traffic (for example railway staff in the eastern parts of Sweden) are far from interested in the "totally unnecessary" introduction of a *new 'stop' hand signal*

And what will happen with possible future demands (from EU?) for harmonization? Will the most commonly used hand signals be forced on to everybody? German, French, Italian, or what?

Fixed signals

Intermittent ATC/ATP-systems exist in Sweden and Norway (a common system) and in Denmark (a separate system) These systems contain all the necessary information for speed supervision (speed limits and braking curves)

Thus the distant signalling and the speed signalling from fixed signals can be considered superfluous A simple two aspect signalling system ('stop'/'proceed') would be all that is needed

In Denmark, a project of introducing this simplified system ('Reduced Exterior Signalling') is far on its way A similar project is also going on in Sweden

Language

The close relationship between the Scandinavian languages has of course advantages, but also many disadvantages

* There are some "false friends", i e words that are the same (or almost) but have different meanings

* Since the languages are close, the schools teach the neighbouring languages to children only to very small extent Schools with such education for adults do not exist. You are very much left to yourself, if you are interested in learning the neighbouring languages (This is however not a big problem to the Norwegians Because of the great variation of dialects in Norway, Swedish might well be considered to be another Norwegian dialect!)

* Spoken Danish may be difficult to understand to many Swedes. The dialect spoken in the south of Sweden is difficult to understand to many Danes

* The Danish numerals are complicated (The Danish word for '74' is a shortening of an expression that literally means 'four plus three and a half times twenty'!)

For the traffic on the coming Öresund link there have been in Sweden some more or less serious discussions about using the language that many Scandinavians consider to be *the* international language English The main reason for using English would be that most Swedes and Danes know English well enough. This however does not seem to be a good idea·

* Using English would make it necessary to create one Swedish type of "Technical Railway English" (translation of Swedish traffic safety rules) and one Danish type of "Technical Railway English" (translation of Danish traffic safety rules) The Danish train crews would have to learn the Swedish rules in English, as well as the Swedish signalmen would The Swedish train crews and the Danish signalmen would learn the Danish rules in English

* The two types of Railway English would inevitably contain words that are the same, but do not mean exactly the same The Railway English (both Swedish and Danish type) would contain many railway expressions that could in no way be used in the English speaking parts of the world, or anywhere else outside the region of Copenhagen - Malmo This is particularly true, as we are not part of the British (or American) philosophy for traffic safety rules, but more of the German one

* Last but not least Many of the staff would still communicate using their own language

The only reasonable solution seems to be to use our own Scandinavian languages Potential disadvantages can be overcome by

* training the staff to listen to the other language (Danish teachers should teach the Danish rules to Swedish train crews, and vice versa)
* instructing (and supervising) everybody to speak his own language clearly and slowly (This particularly applies to Traffic Control staff, that do not need to learn the rules of the other country)
* making agreements on how to handle certain difficulties, such as numerals, e g for train numbers and signal designations. (Unless the Danes agree to say the numerals in Swedish, English might be a good solution for this purpose!)

Conclusions

1 It is more difficult than you might think to harmonize traffic safety rules, also between countries with very similar background

2 Generally, we believe that most problem areas are identified

3 In a few areas the harmonization process has begun, but most of the work remains to be done

4 We are now close to a point where to choose which path to follow Harmonization will no doubt cost a lot of money and require considerable human resources. But if we choose not to go on with the work, we must be aware of what will be the result of this decision.