# *Human Factor Precursors in Railway Data Bases*

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# Railway Safety Role (1)

Includes:

- Lead long term safety strategy for the Railway Group
- Measure and report on safety performance
- Provide safety intelligence and risk information

# Railway Safety Role (2)

Risk based decision making

- Industry standards
- Research and development
- UK and European legislation
- Independent assessment of safety cases
- Audit processes

# Safety Risk Model

A comprehensive model of the risk profile on Railtrack-controlled infrastructure covering all known hazards and their consequences

# What it does

- Risk profile on RCI
  - Continuous updating
- Sensitivity analysis
  - What if’s
- Risk intelligence to audit and standards processes
- Basis of future risk assessments and risk analysis

# Safety Risk Model concept

- To increase the understanding of the risk profile on Railtrack-controlled infrastructure (RCI) to the exposed populations of:
  - Passengers
  - Workers
  - Members of the public
- Enable risk based decision making

# Identification of hazardous events

- A hazardous event is an event which has the potential to lead directly to death or injury
- Identification of hazardous events was through an iterative process that used a list of 18 generic injury mechanisms such as:
  - Being crushed
  - Electric shock
  - Falling
  - Being hit
  - Being trapped

# *Identification of hazardous events*

- This iterative process identified 110 hazardous events
- Three categories:
  - Train accidents (24)
  - Movement accidents (32)
  - Non-movement accidents (54)

# Identification of precursors

- A precursor (cause) is a:
  - System failure
  - Sub system failure
  - Component failure
  - Human error or physical effect

  which could individually or in combination with other precursors (cause) result in the occurrence of a hazardous event eg
  - Broken rail
  - Disregard SPAD
  - Dragging brakes

# Identification of precursors

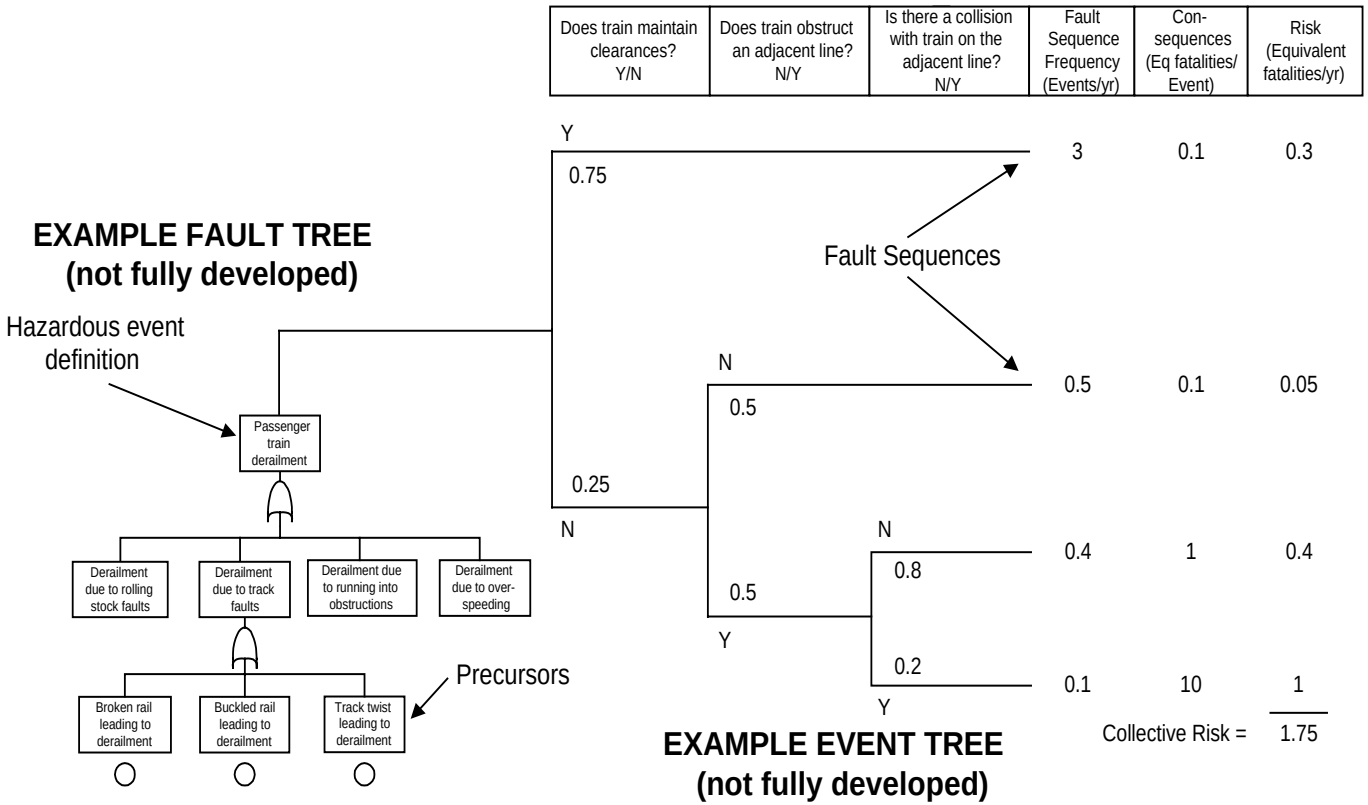
- A precursor (consequence) is a:
  - System failure
  - Sub system failure
  - Component failure
  - Human error or physical effect

  which could individually or in combination with other precursors (consequences) result in significantly different outcomes following a hazardous event eg
  - Different times of the day and passenger loadings
  - Different types of track and infrastructure features
  - Toxic goods release
  - Fire

# Precursor source data

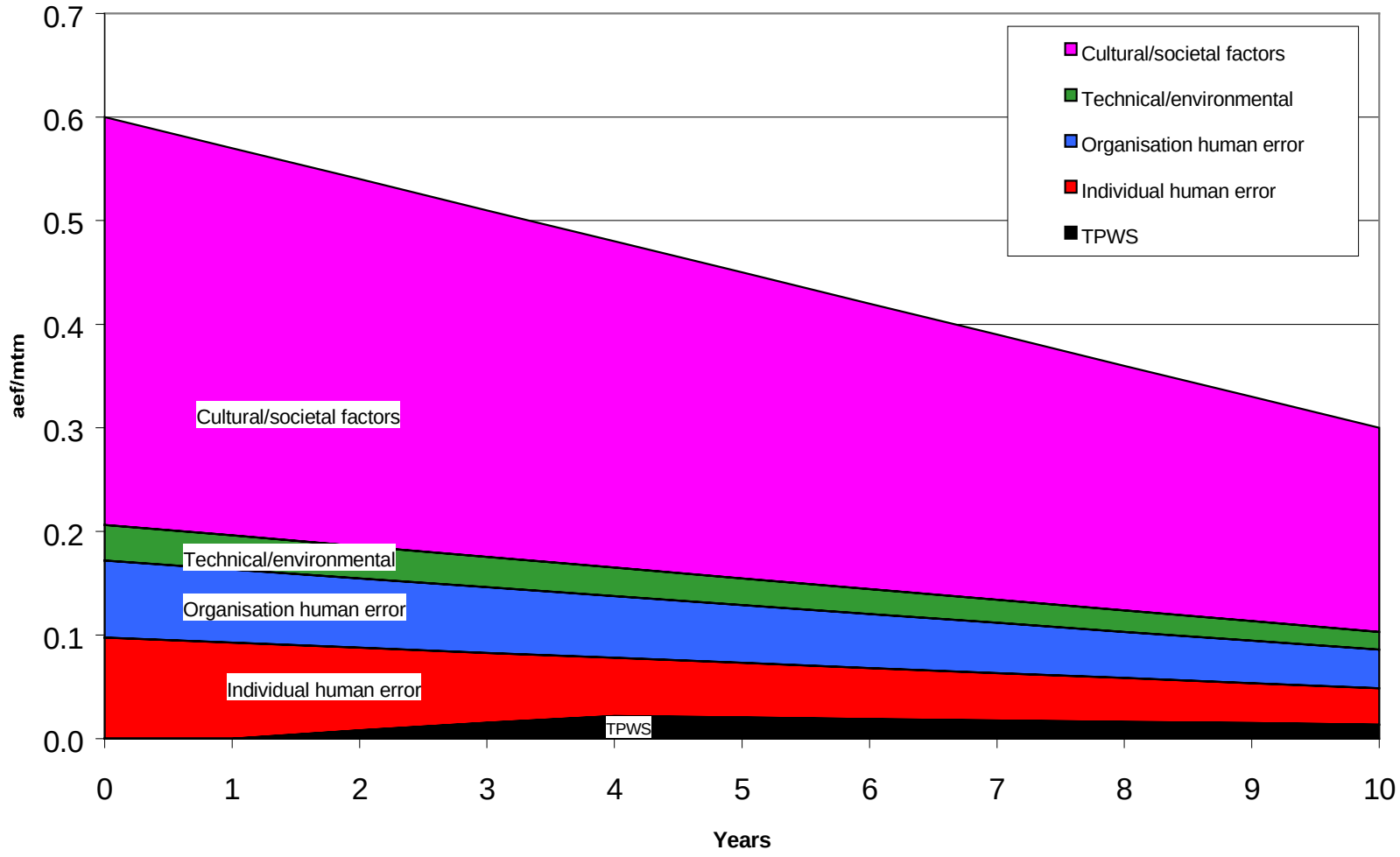
| | |
|---|---|
| • SMIS | All safety related incidents |
| • AEA Derailment database | Dangerous good occurrences |
| • HMRI Database | All reportable accidents 1994 - 1997 |
| • Geogis Database | Records of infrastructure |
| • Raildata | Broken rails |
| • Accident Consequences | Lists accidents between 1967 -1998 involving injury to passengers |
| • Train Miles | Paladin |

# Model example




RELATIONSHIP BETWEEN FAULT TREE AND EVENT TREE ANALYSIS

# Breakdown of ten-year target

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# The human machine interface

- Individual
- Organisational
- Societal/Cultural

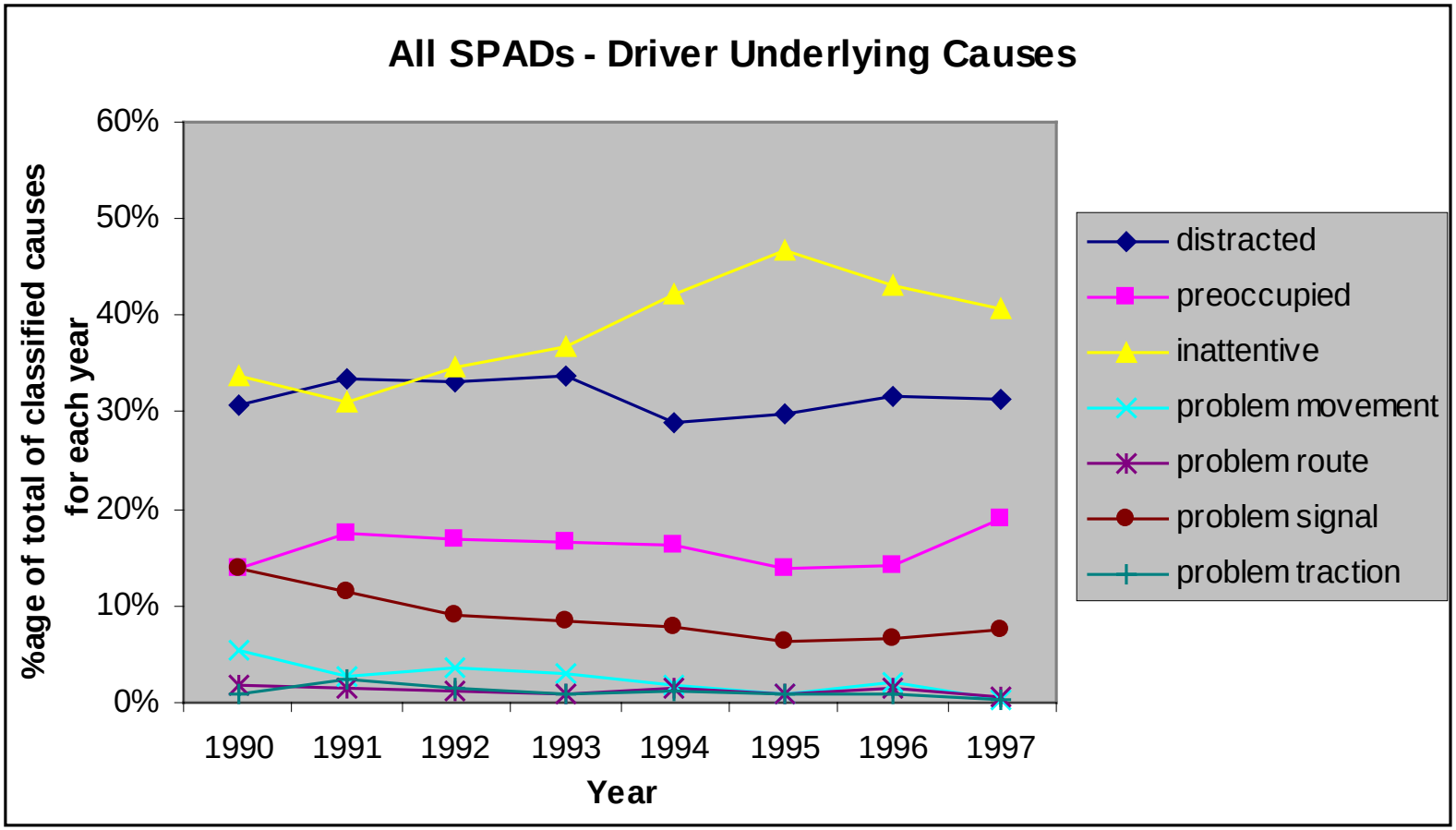
# SMIS

- Safety Management Information System
- Contains some human factor precursors
- Mainly related to SPADs

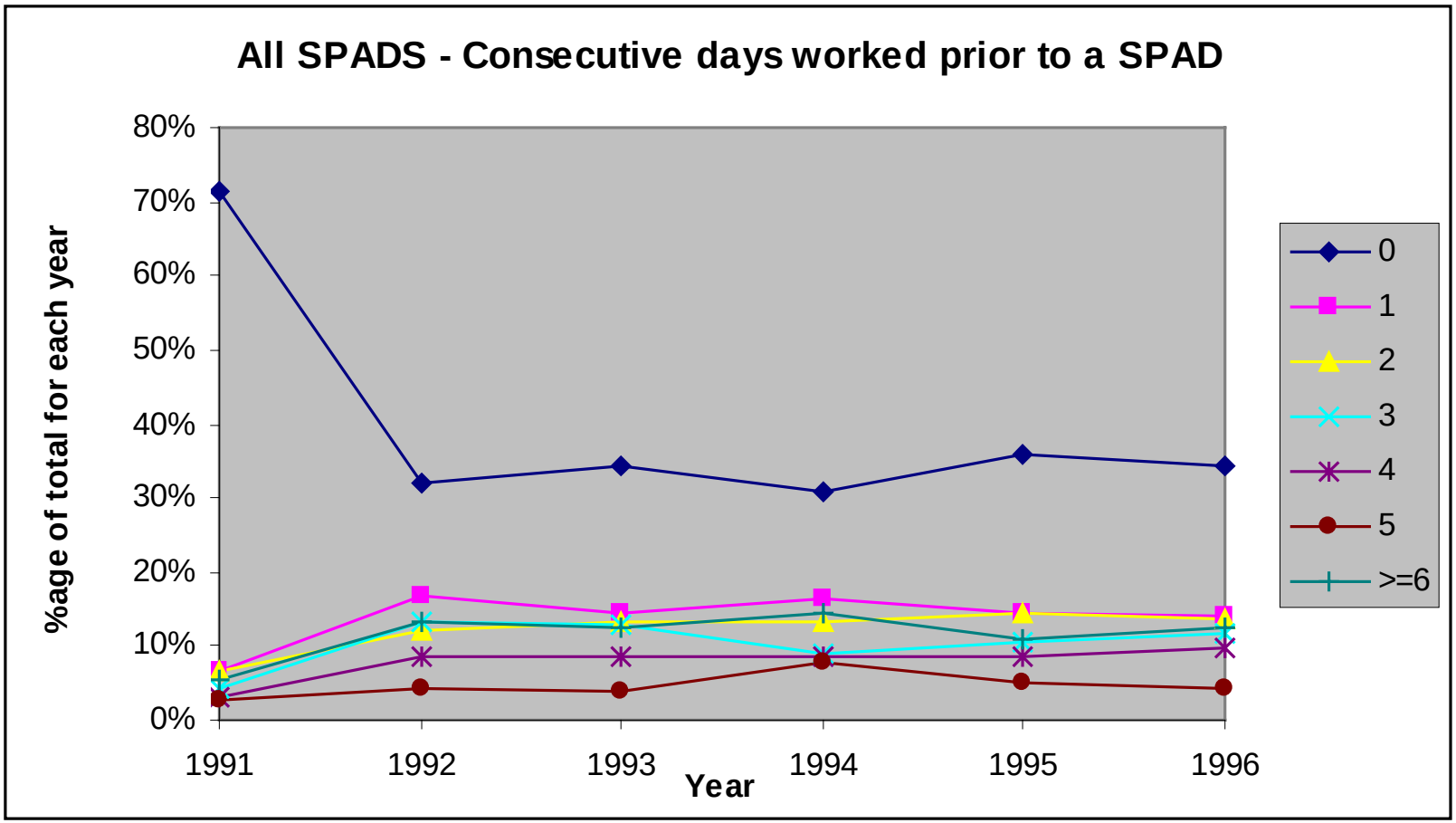
# SPAD human factor precursors

- Anticipation of signal clearance
- Failure to check signal aspect
- Failure to locate signal
- Failure to react to caution signal
- Ignorance of rules/instructions
- Violation of rules/instructions
- Ambiguous/incomplete information given
- Information not given
- Wrong information given
- Correct information given but misunderstood
- Misjudged train behaviour
- Misjudged environmental conditions
- Viewed wrong signal
- Misread previous signal
- None of these
- Viewed correct signal misread aspect
- Type not known (disregard)
- Type not known (miscom)
- Type not known (misread)
- Type not known (misjudge)

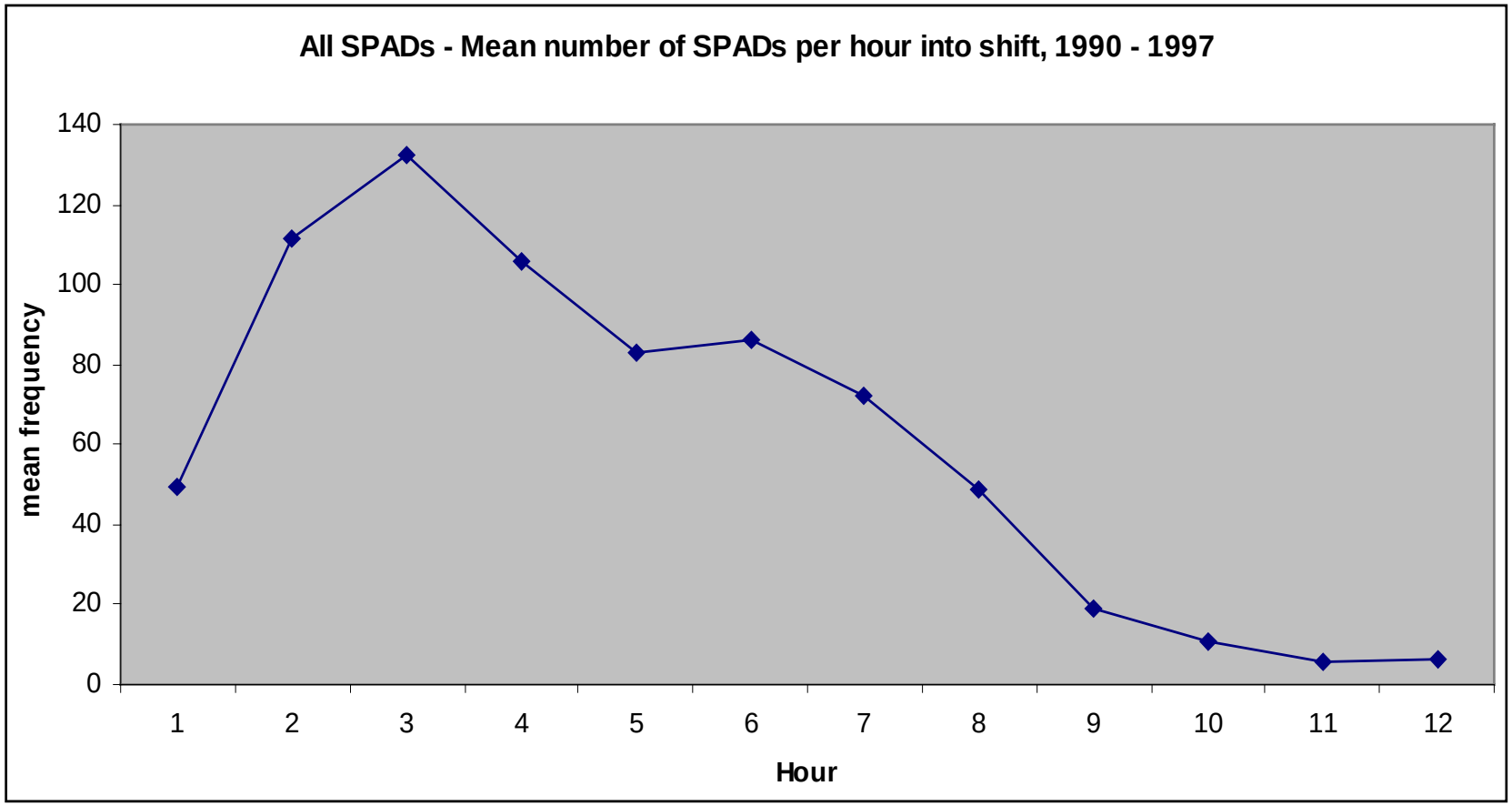
# Huw Gibson analysis-1



# Huw Gibson analysis-2



# Huw Gibson Analysis-3

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# SMIS enhancement

| Groups | Lowest level |
|---|---|
| • Attention | 17 |
| • Motivation | 11 |
| • Personal factors | |
| • fatigue | 7 |
| • physical fitness | 6 |
| • competence | 15 |
| • Communication | 13 |
| • Supervision/management control | 8 |
| • Workplace | 31 |
| • Equipment factors | 25 |
| • Maintenance of equipment | 5 |
| • Workload | 9 |
| • Procedures | 30 |
| | 177 |

# SMIS enhancement

Personal factors - fatigue precursors

- Shift pattern
- Medical treatment
- Domestic issues
- Lifestyle
- Type of work
- Workload
- Influence of drugs and alcohol

# Precursor Indicator Model - overview

- Measures the underlying risk of a train accident
- Provides an indicator of whether the risk is increasing or decreasing
- Based on the precursors identified in the Safety Risk Model

# Precursors are best practice

- Studying the past performance of train accidents will not necessarily indicate when the next one will be
- By studying the precursors we can get a feel for the underlying risk and react to increases as necessary

# The precursors

- Identified by the Railway Safety Risk Analysts as part of the development of the Risk Model
- There are 809 Train Accident precursors in the Risk Model
- The Precursor Indicator Model (PIM) has grouped them into 33 groups including SPADs, level crossing misuse, train fires and vandalism

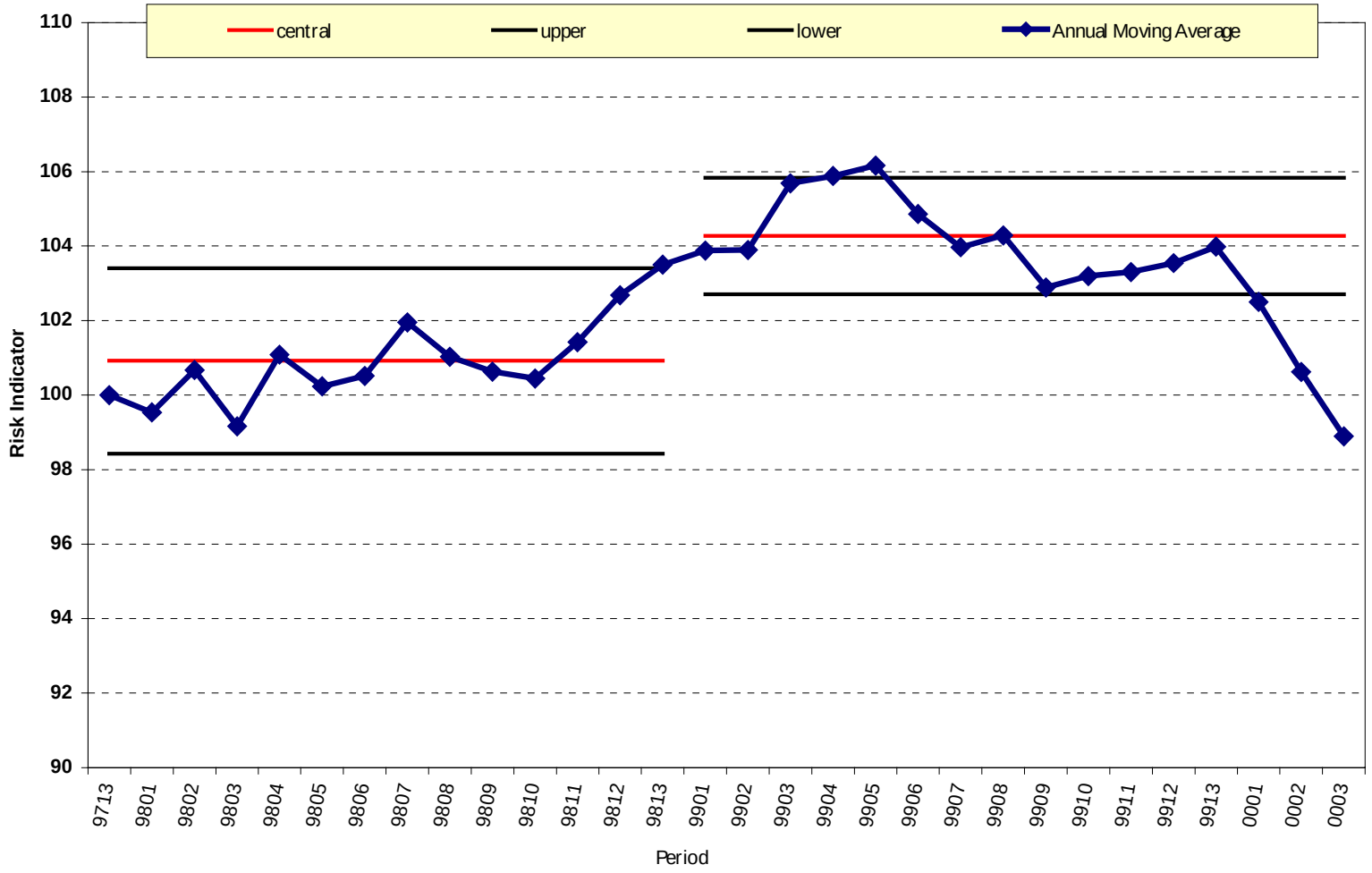
# Indicator Model precursors

- Category A SPADs (by error type)
- Track quality
- Level crossing misuse
- Train fires
- Irregular working
- Traction failures
- Environmental incidents
- Vandalism
- Structural failures
- Level crossing failures
- Speeding incidents
- Irregular loading of freight trains
- Animals on the track
- Wrongside signalling failures
- Possession irregularities
- Non-rail vehicle incidents

# Precursor data

- The data is collected every four weeks
- The model has data going back to April 1997
- Because some of the data is seasonal, an annual moving average is used
- The annual moving average for the end of the first year is rebased to 100, to make future comparisons easier

# Precursor Indicator Model results



# Conclusions

- Precursors are important
- Most of the risk is in human factors
- If you want to understand your risk, identify and measure your human factor precursors

# *Human Factor Precursors in Railway Data Base*

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