# MODELLING OF HUMAN AND HUMAN-SYSTEM INTERACTIONS FOR RAILWAY SAFETY


Individual Project

Safety by Design

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# SYSTEM

System: Railways

Sub systems :

- Trackside control & signalling
- On-board control & signalling
- Comfort facilities
- Climate control
- Communication system
- Power supply
- Physical(incl. Railway tracks)

# HUMANS

Various groups of humans interact with railways:

- Passenger
- Train operators
- Government
- Railway company
- Railway Service Providers
- Third parties

# ENVIRONMENT

The environment which deals with humans and railways includes:

- Other modes of transport
- External physical environment

# INTERACTION

Human-railway system interaction happens in various forms:

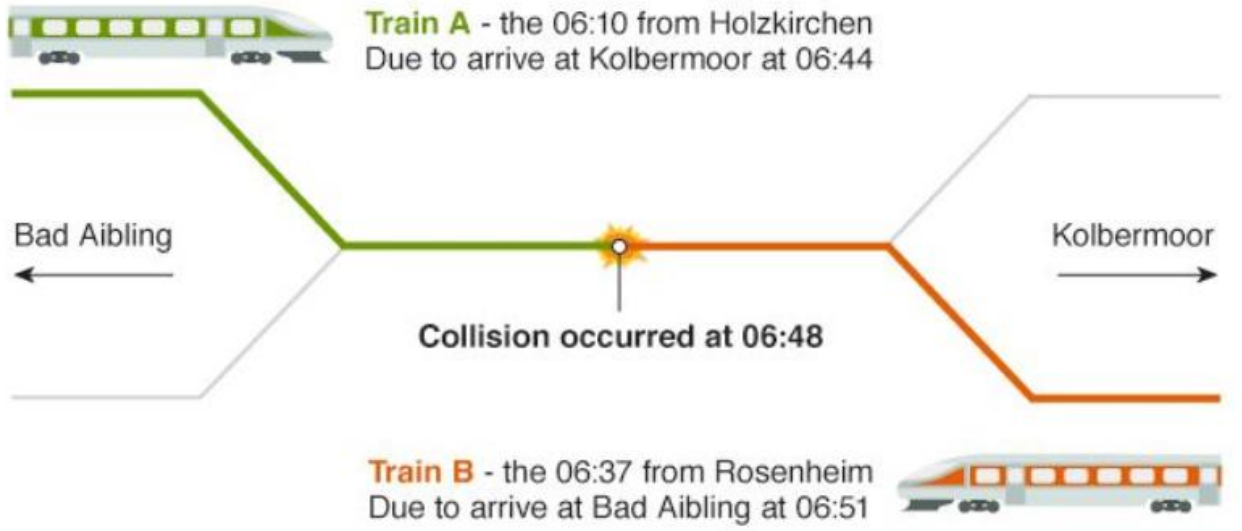
- ***Passengers*** expect comfortable travelling experience but should not vandalize the train.
- **Drivers** expect a smooth driving interface to use but are expected to be well trained and fit while driving.
- ***Maintenance workers*** expect ease of access to the parts which require maintenance but are required to finish work within time and stay aware of incoming trains if they work on railway tracks.
- ***Third party*** expects to be given protection from railway hazards and are expected to be responsible towards protecting railway infrastructure.
- ***Government*** is bound to provide infrastructure and enable railways to be affordable and safe for all citizens. However the government also expects contractors to perform tasks within time to ensure there are no roadblocks to the modernization of railways.

# BAD AIBLING RAIL ACCIDENT

- 9 February 2016 in Bavaria, Germany
- 2 Passenger trains collided and 12 died and 85 were injured including 24 seriously injured.

Investigations found that :

- Track controller gave incorrect orders to the two trains while distracted by a game he was playing on his mobile phone.
- He further compounded his error when, he tried to send emergency codes to the trains but entered the wrong combination into his computer.
- Automatic signalling system which is supposed to kick in when a train runs through a red light was switched off to let the eastbound train travel faster

# SAFETY REGULATIONS

Different types of safety regulations:

- Type A - Basic safety standards: basic concepts, principles for design and general aspects.
- Example: ISO 12100 - design standards for all machinery
- Type B - Generic safety standards: one safety aspect which can be used across wide range of machinery
- Type C – Detailed safety standards with detailed requirements for particular group of machines

# HAZARD IDENTIFIED

***Hazards due to train driver:***

- Train driver falls ill during duty
- Signal passed at danger by driver
- Unruly behaviour by train driver
- Lack of focus on track by train driver

***Hazards due to passengers:***

- Humans on board the train who could harm other passengers physically
- Passenger falls sick inside the train

***Hazards due to others:***

- Negligence by humans on railway crossings
- Error by track controller while switching gears
- Inappropriate separation between un-insulated live conductors and the public
- Humans attempting suicide on railway tracks

# CONTROL OF HAZARDS

Method: ***Preliminary hazard analysis and Risk assessment matrix***

- Redesign system to reduce or eliminate hazard
- Use safety devices
- Install warning systems near areas prone to hazard
- Carry out special procedures and training for staff
- Spread awareness

# WHICH HAZARDS ARE CONTROLLED?

- High risk hazards are controlled.
- For medium risk hazards, cost benefit analysis is conducted.
- If the spending justifies the safety provided,  then medium and low risk hazards can be controlled.

Example of hazard control:

***Error by track controller while switching gears:***

- Provide a simpler software interface and real time data
- Provide continuous training to use the systems
- Add automation to guide human controller's decisions
- Ensure controller is not occupied with other tasks during work

# SAFETY INDICATORS

***Leading indicators***: They are proactive in nature. They consist of safety initiatives or reported activities, with the aim of preventing hazardous events before they occur.

Example: Providing training to drivers, participation in safety committees etc.

***Lagging indicators***: They are reactive in nature and measures the effectiveness of safety programs after details are known.

Example: Number of accidents, days away from work etc.

# SAFETY CULTURE

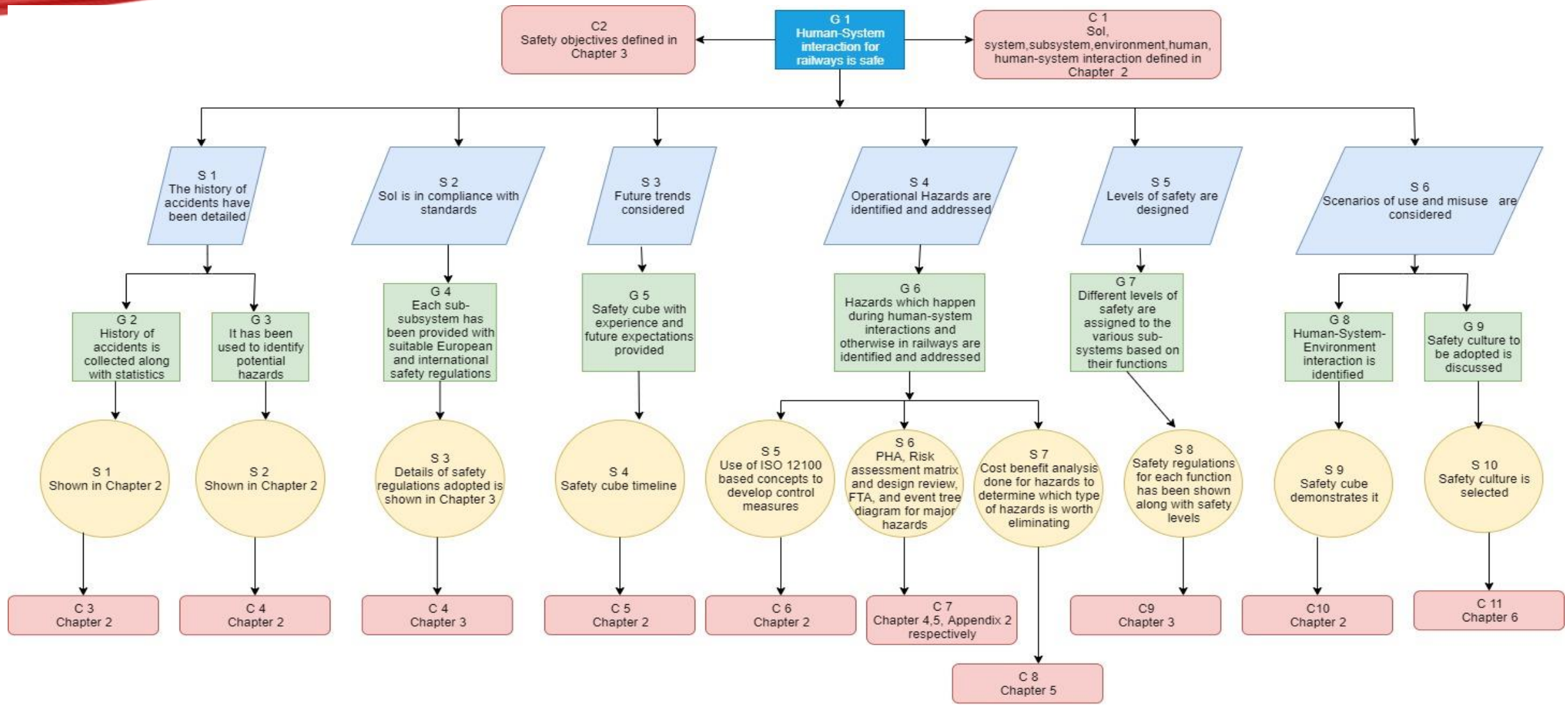
- Humans are ***unpredictable.***
- Human- railway system interaction is unforeseeable.

Desired :

- Constant monitoring of safety standards.
- Active support from top level managers.
- Integrate safety into company's long term strategy.

Thus an "optimized" level of safety culture is suitable.

# PROVING SAFETY



# CONCLUSION

- Human interaction happens at various levels with the system.
- Hazards should be constantly identified and eliminated.
- Proper safety culture must be promoted.
- Ensuring human-railway system safety is the task of all humans involved in the use of the railway system.

# QUESTIONS?