

# Wayside Train Monitoring Systems in Switzerland: no compromises on safety



**Giuliano Montanaro, CEO**  
alius consulting GmbH  
Zürich, Switzerland

Rail Conference

alius consulting



# Summary

1. Main Information's about the Swiss Federal Railways and the Swiss Rail Network
2. The aim of the project “Wayside monitoring» : the new very long tunnel in Switzerland
3. The reality of the daily operations
4. Feedback and consequences
5. Prevention is better than cure : the Swiss WTMS – Wayside Train Monitoring Systems
6. Conclusions

# 1. Some main information's about the railway system in Switzerland

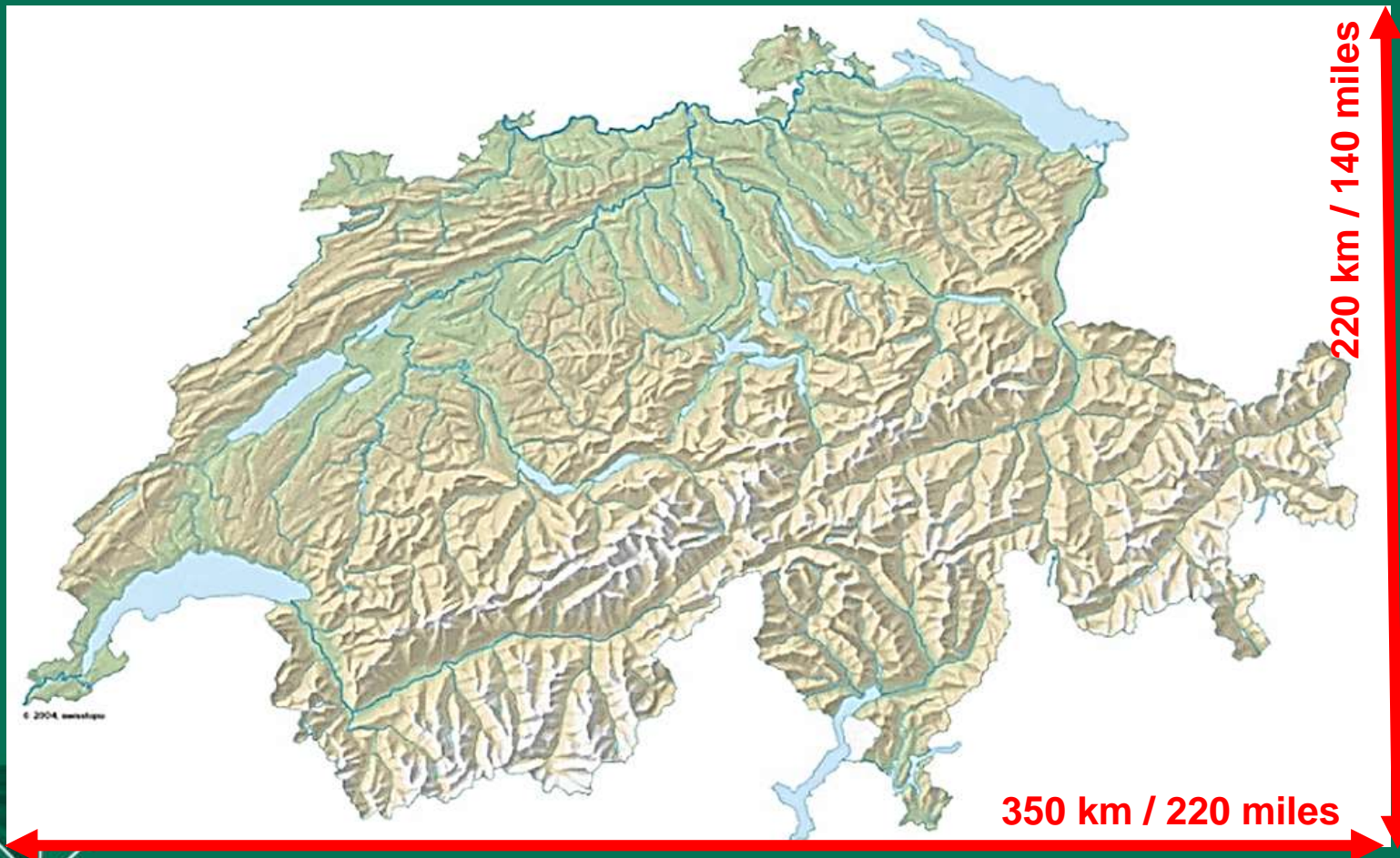
Switzerland: a small country in the heart of Europe.



Wayside Train Monitoring Systems in Switzerland:  
no compromises on safety

# 1. Some main information's about the railway system in Switzerland

A small Confederation full of mountains and with 4 languages...



Wayside Train Monitoring Systems in Switzerland:  
no compromises on safety

# 1. Some main information's about the railway system in Switzerland

But with a very dense railway network ...



Wayside Train Monitoring Systems in Switzerland:  
no compromises on safety

# 1. Some main information's about the railway system in Switzerland

... that is the most densely used in term of train traffic and one the most frequented in term of passengers in the world!

❑ Freight modal share for rail: ~ 45%

position 5 in the world with the USA and European champion

❑ Passenger modal share for rail: ~ 17%

position 2 in the world after Japan and European champion

❑ Passenger-km travelled per year and per inhabitant:  
~ 2'200 position 1 in the world ahead Japan



Wayside Train Monitoring Systems in Switzerland:  
no compromises on safety

# 1. Some main information's about the railway system in Switzerland



*Zurich main station, one of the busiest rail station in Europe, with more than 450'000 passengers and 1'500 trains each day*



*The Gotthard rail tunnel, the longest rail tunnel in the world (57 km)*

Wayside Train Monitoring Systems in Switzerland:  
no compromises on safety

# 1. Some main information's about the railway system in Switzerland



Wayside Train Monitoring Systems in Switzerland:  
no compromises on safety



## 2. The aim of the project “Wayside monitoring» : the new very long tunnel in Switzerland

The freight traffic is very dense and the rail is also the most secure transport system for the transport of dangerous goods. Some years ago the question was:

→ how to ensure the maximum of security and prevent an accident in this new infrastructure ?

The old Gottahrd line



The new Gotthard base tunnel



Wayside Train Monitoring Systems in Switzerland:  
no compromises on safety

## 2. The aim of the project “Wayside monitoring» : the new very long tunnel in Switzerland

	<i>country</i>	<i>km</i>	<i>in service since</i>	
<b>1</b>	<b>Gotthard</b>	<b>Switzerland</b>	<b>57</b>	<b>2016</b>
2	Seikan	Japan	54	1983
3	Channel	France-GB	50	1993
<b>4</b>	<b>Lötschberg</b>	<b>Switzerland</b>	<b>35</b>	<b>2007</b>
5	Guadarrama	Spain	28	2007
5	Taihang	China	28	2008
7	Hakkōda	Japan	26	2010
7	Iwate-Ichinohe	Japan	26	2002
9	Tianshan	Chine	22	2012
9	Dai-shimizu	Japan	22	1982
11	Wushaoling	China	21	2006
11	Lüliangshan	China	21	2011
13	Geumjeong	South-Corea	20	2010
13	Simplon	Switzerland -Italy	20	1905
14	Vereina	Switzerland	19	1999

Wayside Train Monitoring Systems in Switzerland:  
no compromises on safety

## 2. The aim of the project “Wayside monitoring» : the new very long tunnel in Switzerland

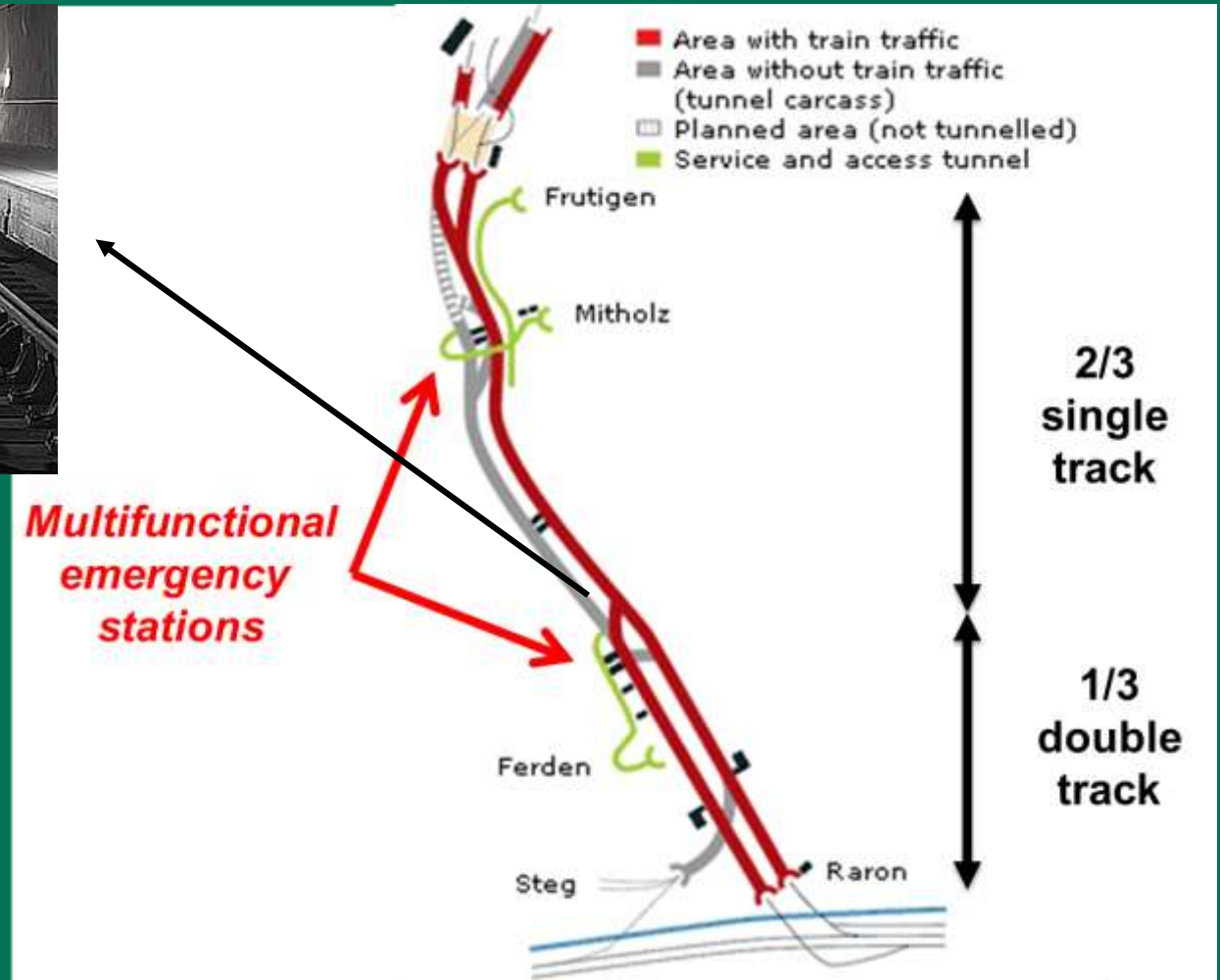


Wayside Train Monitoring Systems in Switzerland:  
no compromises on safety

## 2. The aim of the project “Wayside monitoring»: The Lötschberg Tunnel, 35 km



switch in the middle of the tunnel



Wayside Train Monitoring Systems in Switzerland:  
no compromises on safety

## 2. The aim of the project “Wayside monitoring»: The Lötschberg Tunnel, 35 km



security communications doors



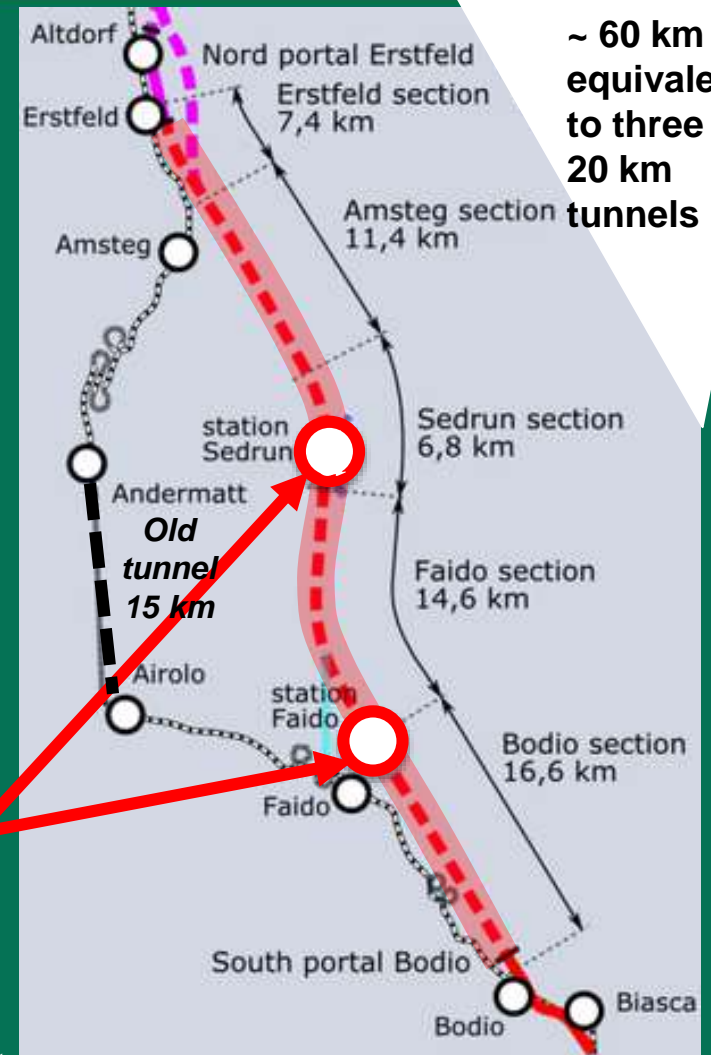
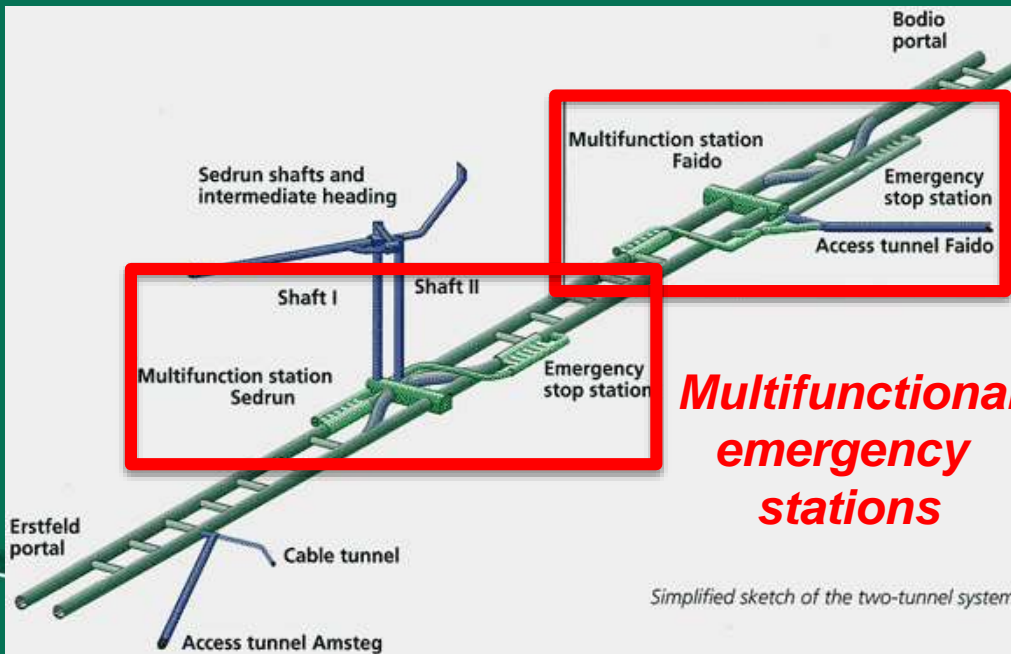
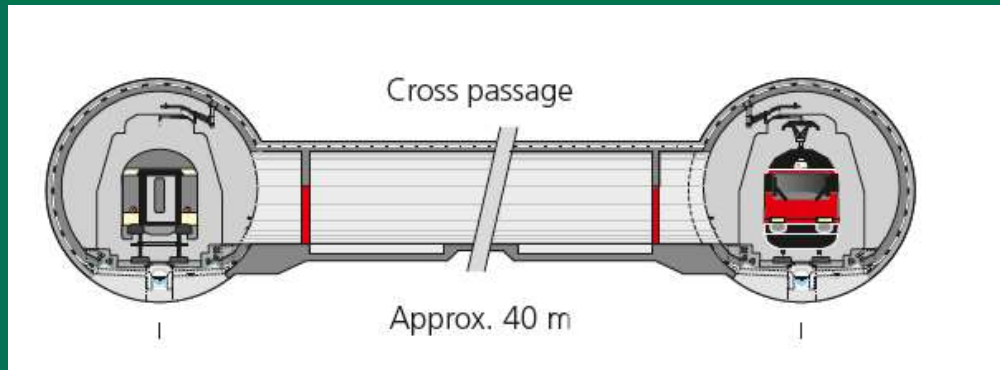
ventilation

~ 100 trains/day  
(200km/h passenger's  
and 100 km/h freight)



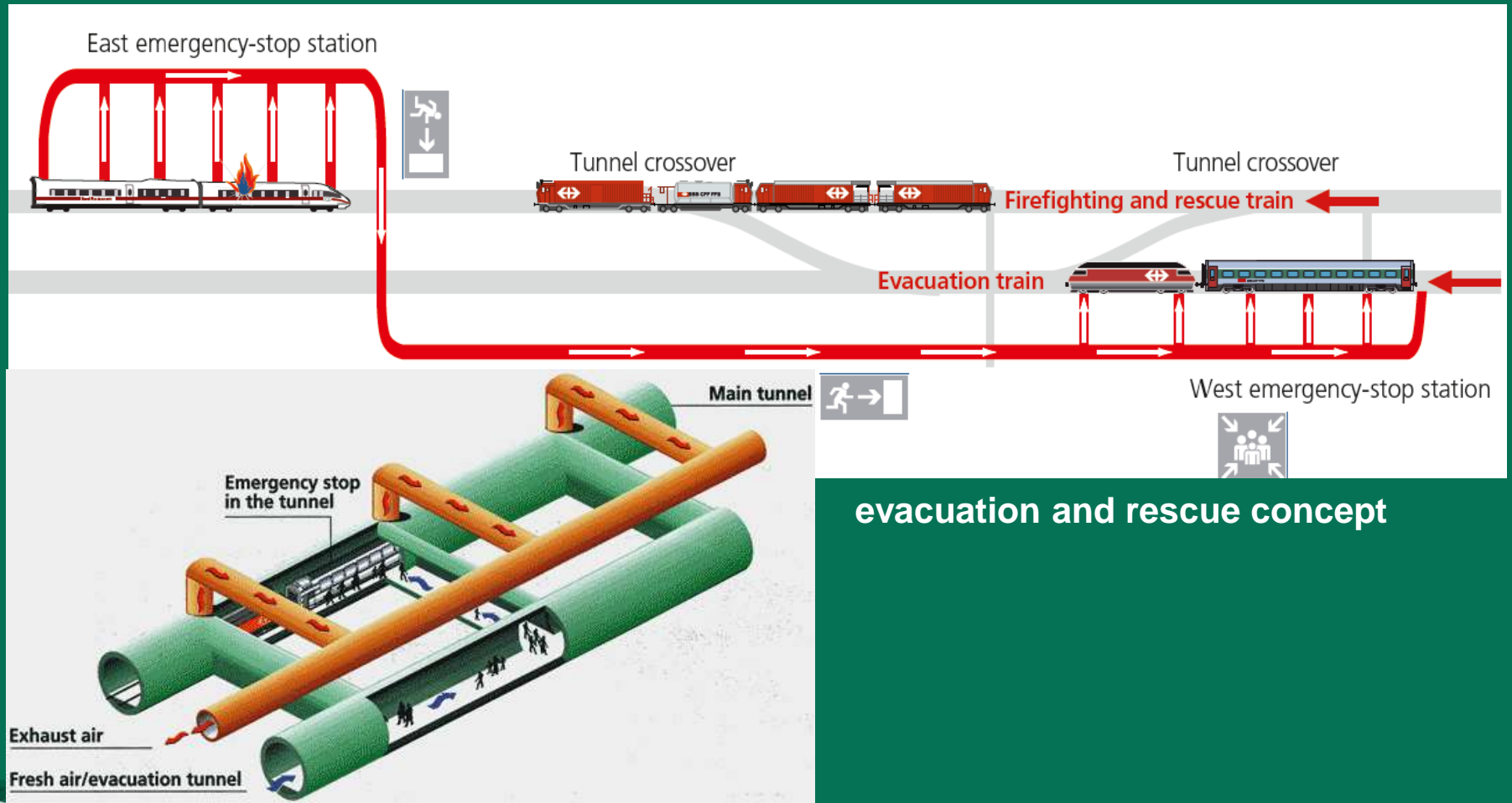
Wayside Train Monitoring Systems in Switzerland:  
no compromises on safety

## 2. The aim of the project “Wayside monitoring»: The Gotthard base Tunnel, 57km



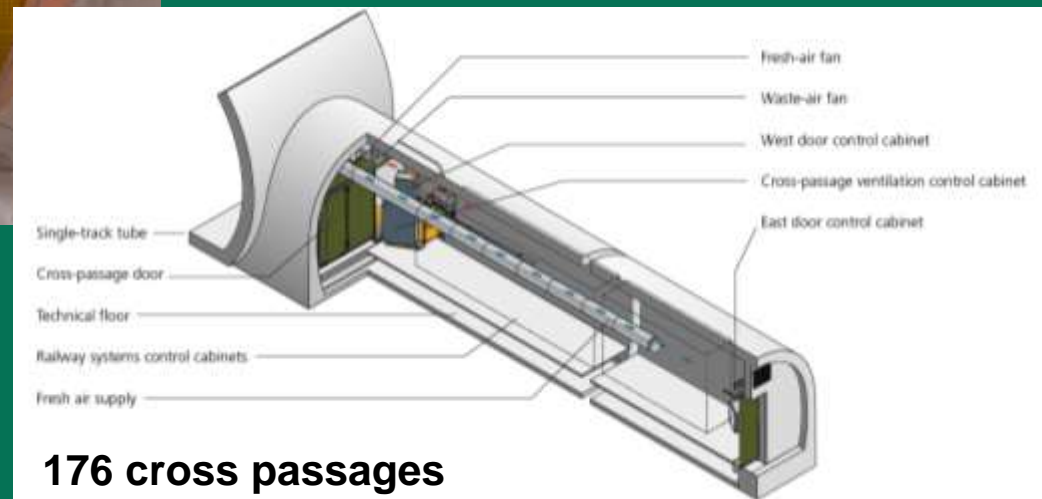
Wayside Train Monitoring Systems in Switzerland:  
no compromises on safety

## 2. The aim of the project “Wayside monitoring»: The Gotthard base Tunnel, 57km



Wayside Train Monitoring Systems in Switzerland:  
no compromises on safety

## 2. The aim of the project “Wayside monitoring»: The Gotthard base Tunnel, 57km



**176 cross passages**

Wayside Train Monitoring Systems in Switzerland:  
no compromises on safety



## 2. The aim of the project “Wayside monitoring» : the new very long tunnel in Switzerland

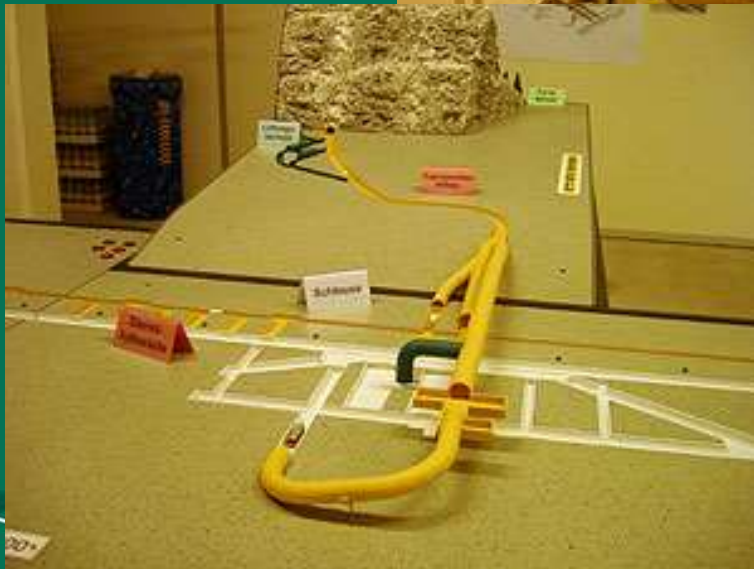
Special rescue trains.



Wayside Train Monitoring Systems in Switzerland:  
no compromises on safety

## 2. The aim of the project “Wayside monitoring» : the new very long tunnel in Switzerland

the training  
and  
emergency  
center



Wayside Train Monitoring Systems in Switzerland:  
no compromises on safety

## 2. The aim of the project “Wayside monitoring» : the new very long tunnel in Switzerland

simulation of accident  
and training



Wayside Train Monitoring Systems in Switzerland:  
no compromises on safety

### 3. The reality of the daily operations



Real evacuation for a technical problem of a passenger train



Wayside Train Monitoring Systems in Switzerland:  
no compromises on safety

### 3. The reality of the daily operations

The real risks: a tilting train accident on the old Gotthard line



Wayside Train Monitoring Systems in Switzerland:  
no compromises on safety

### 3. The reality of the daily operations

The real risks: problem with freight wagons



Wayside Train Monitoring Systems in Switzerland:  
no compromises on safety

### 3. The reality of the daily operations

The big accident in the Simplon tunnel in 2011



Wayside Train Monitoring Systems in Switzerland:  
no compromises on safety

### 3. The reality of the daily operations

800° Celsius and damage for over 130 million of \$ !



Wayside Train Monitoring Systems in Switzerland:  
no compromises on safety



## 4. Feedback and consequences

Even with the best constructions, technology, equipment, systems, processes, means of intervention ...

**PREVENTION IS ALWAYS BETTER ....  
THAN CURE!**

The basic principle:

**ONLY ONE TRAIN "HEALTHY"  
MUST ENTER THE TUNNEL ...**

**B U T H O W ?**

Wayside Train Monitoring Systems in Switzerland:  
no compromises on safety

# 5. Prevention is better than cure : the Swiss WTMS – Wayside Train Monitoring Systems

ZKE Netzkarte





Stand: 01.01.2013 / I-AT-U EW-ZKE

SBB CFF FFS



More than 200 operational installations

Legende

-  Heissdampf- und Festbremseinstellung
-  Brand- und Chemierung
-  Profil- und Arterkennung
-  Dragging Equipment Detector
-  Achsenbenutzungsanlage

Wayside Train Monitoring Systems in Switzerland:  
no compromises on safety

# 5. Prevention is better than cure : the Swiss WTMS – Wayside Train Monitoring Systems

## Installation overview.

### Profil and antenna localisation (safety)

- Prevention of damage to clearance profiles
- Prevention of contact with overhead traction lines through vehicle antennas on piggyback transport trains

### Fire and chemical detection (safety)

- Prevention of situations which are critical to safety as a result of fire or hazardous substance spillages

### Hot axle box and blocked brake detection (safety)

- Prevention of derailments due to broken axles and wheels

### Wheel-load checkpoints (safety)

- Detection of load displacement and overloading
- Serious wheel errors
- Track-system burdens

### Panto monitoring (availability)

- Uplift-measurement / optical monitoring
- Prevention of problems in overhead traction lines

### Magnetic field measurement (availability)

- Prevention of disruption to track-ahead free signals

### Nature hazards (safety)

- Prevention of collisions with material from rockfalls / landslides / avalanches

### WTMS network (safety, availability, case management)

- Central acquisition for all alarms and intervention process
- Delivery of data to RUs for **maintenance optimisation** and for **protecting the infrastructure**; e.g. early signalling of out-of-round wheels, defective bogies or incorrect pantograph settings **before a limit is exceeded**.

↔ SBB CFF FFS

Wayside Train Monitoring Systems in Switzerland:  
no compromises on safety

## 5. Prevention is better than cure : the Swiss WTMS – Wayside Train Monitoring Systems

Hot axle box and blocked brake detection.



**100 installations**

**7000 alarms a year**

Wayside Train Monitoring Systems in Switzerland:  
no compromises on safety

## 5. Prevention is better than cure : the Swiss WTMS – Wayside Train Monitoring Systems

### Hot axle box and blocked brake detection

Critical incidents: hot axle box.



**completely destroyed  
axle box**

Wayside Train Monitoring Systems in Switzerland:  
no compromises on safety

## 5. Prevention is better than cure : the Swiss WTMS – Wayside Train Monitoring Systems

### Hot axle box and blocked brake detection

Critical incidents: blocked wheel.



Wayside Train Monitoring Systems in Switzerland:  
no compromises on safety

## 5. Prevention is better than cure : the Swiss WTMS – Wayside Train Monitoring Systems

Wheel-load checkpoints.



**30 installations**

**600 alarms a year**

**load displacement**  
left:right

**maximum axle load**

**brake weight**

Wayside Train Monitoring Systems in Switzerland:  
no compromises on safety

## 5. Prevention is better than cure : the Swiss WTMS – Wayside Train Monitoring Systems

critical incidents: load displacement 1:1.93.



Wayside Train Monitoring Systems in Switzerland:  
no compromises on safety

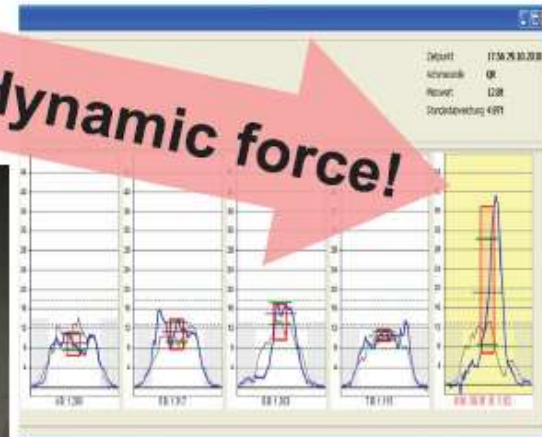


# 5. Prevention is better than cure : the Swiss WTMS – Wayside Train Monitoring Systems

## Detection of Flat wheels

to reduce noise / vibration / protect infrastructure.

40 tons dynamic force!



- destroys infrastructure
- Leads to hot axle boxes

Wayside Train Monitoring Systems in Switzerland:  
no compromises on safety

## 5. Prevention is better than cure : the Swiss WTMS – Wayside Train Monitoring Systems

Profile and antenna localisation.

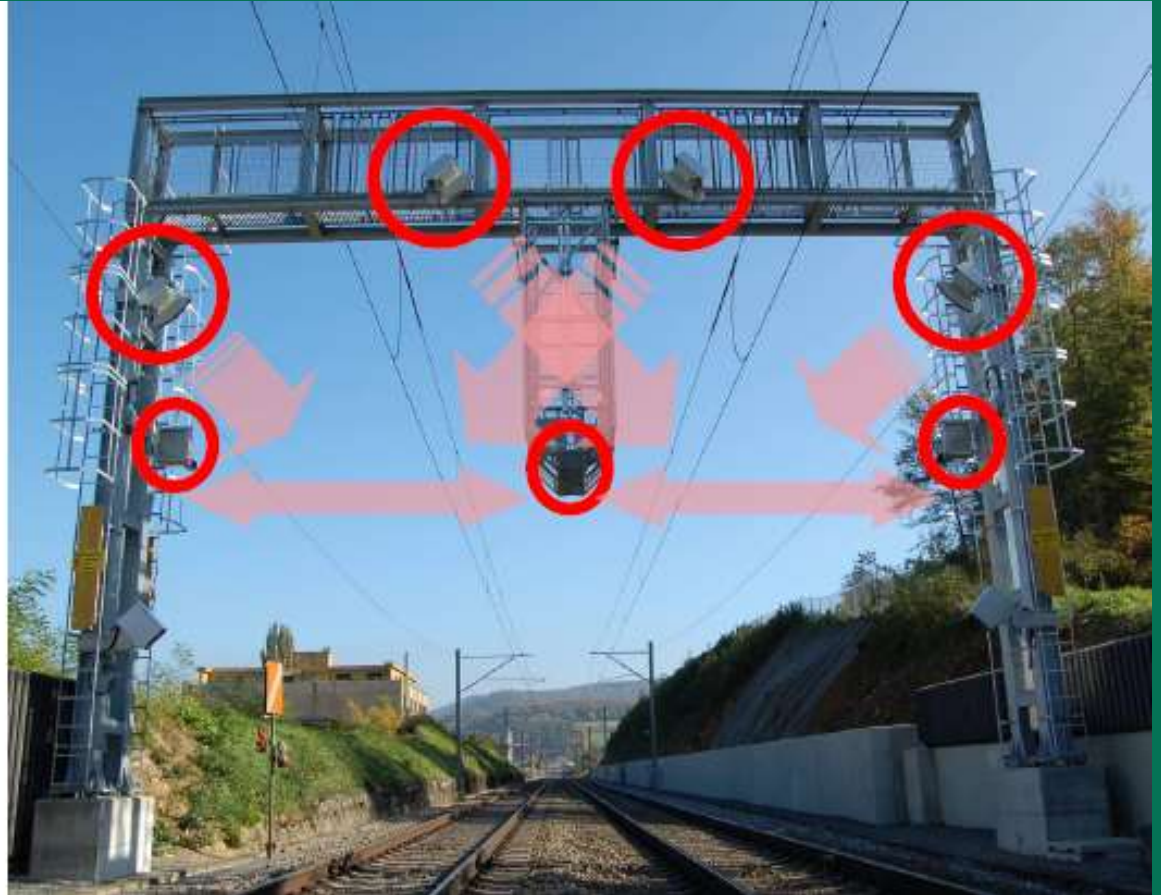


**12 installations**

**200 alarms a year**

Wayside Train Monitoring Systems in Switzerland:  
no compromises on safety

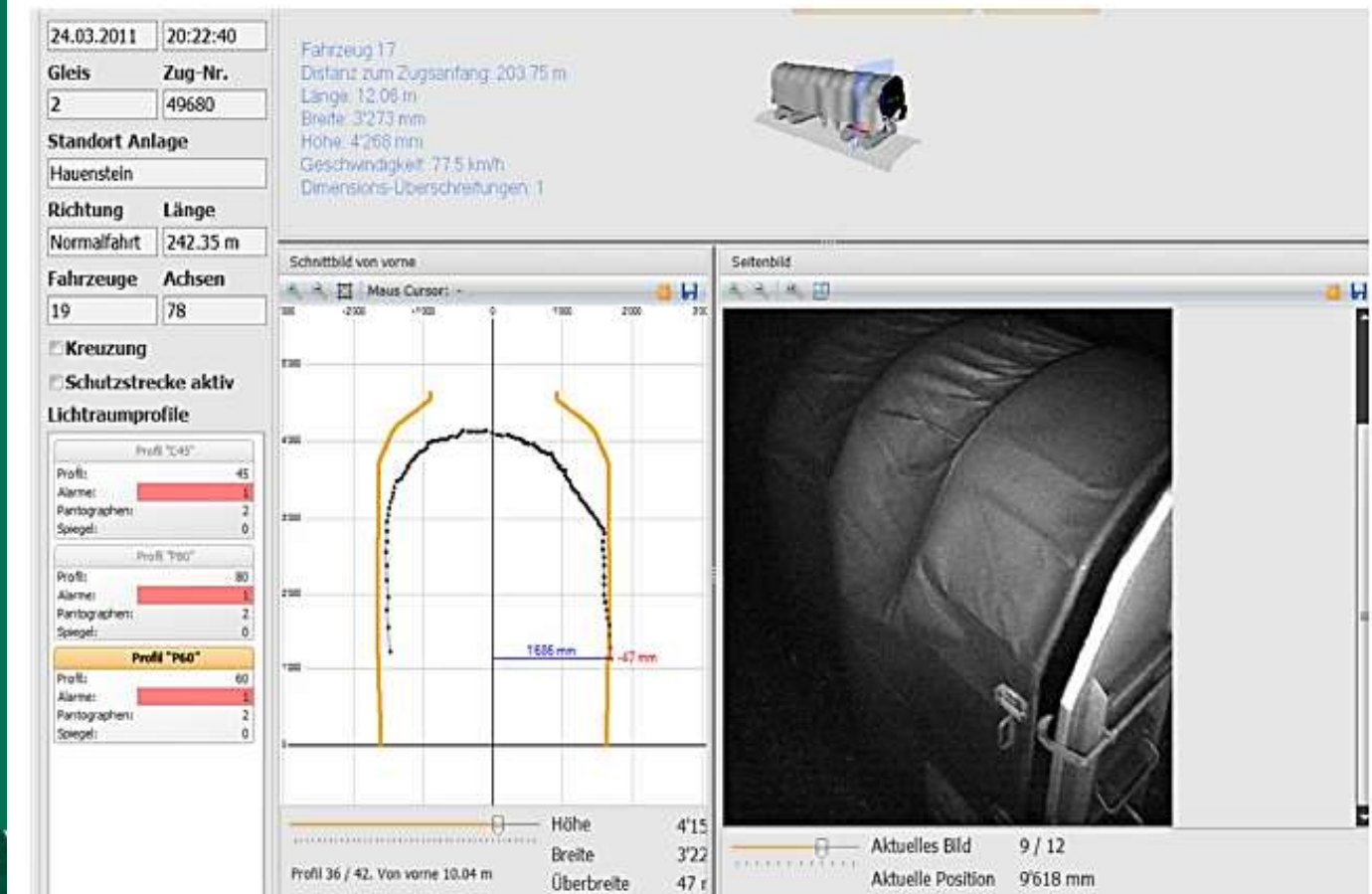
## 5. Prevention is better than cure : the Swiss WTMS – Wayside Train Monitoring Systems



Wayside Train Monitoring Systems in Switzerland:  
no compromises on safety

# 5. Prevention is better than cure : the Swiss WTMS – Wayside Train Monitoring Systems

critical incidents (1): freight wagon with hood.



Wayside Train Monitoring Systems in Switzerland:  
no compromises on safety

# 5. Prevention is better than cure : the Swiss WTMS – Wayside Train Monitoring Systems

critical incidents (2): Truck with open canvas.

**25.07.2011 13:57:10**

<b>Gleis</b>	<b>Zug-Nr.</b>
1	43625

**Standort Anlage**  
Hauenstein

<b>Richtung</b>	<b>Länge</b>
Normalfahrt	426.19 m

<b>Fahrzeuge</b>	<b>Achsen</b>
22	168

Kreuzung  
 Schutzstrecke aktiv

**Lichtraumprofile**

<b>Profil "pao"</b>
Profil: 80
Absele: -4
Parabogramm: 1
Spiegel: 0

**Schnittbild von vorne**

Maus Cursor: -

Höhe: 4547 mm  
Breite: 2671 mm  
Überbreite: 114 mm (Max: 114 mm)

Profil 48 / 56. Von vorne 15.72 m

**Seitenbild**

Aktuelles Bild: 13 / 16  
Aktuelle Position: 16'947 mm

3D Model Data:  
Fahrzeug 17  
Distanz zum Zuganfang: 312.16 m  
Länge: 19.10 m  
Breite: 3052 mm  
Höhe: 4586 mm  
Geschwindigkeit: 83.8 km/h  
Dimensions-Überschreitungen: 4

Wayside Train Monitoring Systems in Switzerland:  
no compromises on safety

## 5. Prevention is better than cure : the Swiss WTMS – Wayside Train Monitoring Systems



Uplift  
measurement



Geology  
detection



Fire and  
chemical  
detection

Wayside Train Monitoring Systems in Switzerland:  
no compromises on safety

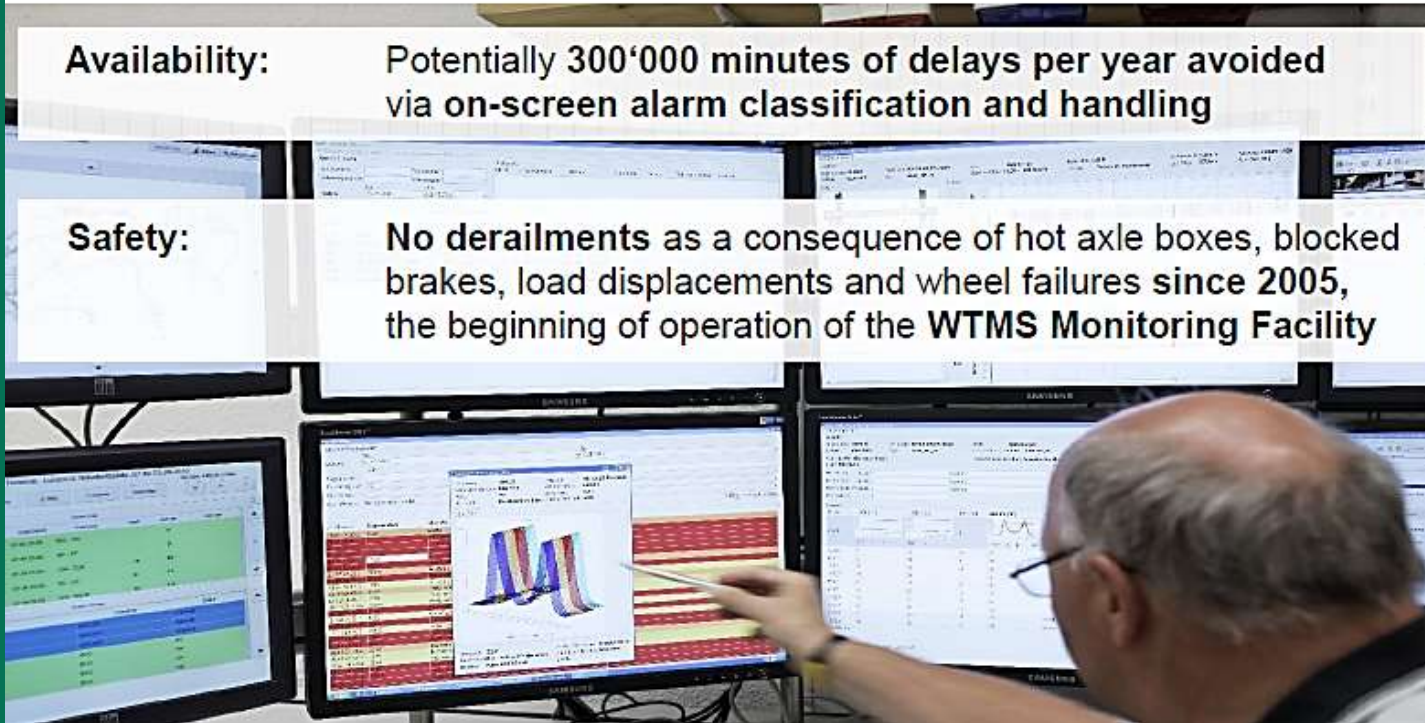
# Wayside Train Monitoring Systems in Switzerland: no compromises on safety

## Consistently networked WTMS.

A verifiable success story.

**Availability:** Potentially 300'000 minutes of delays per year avoided via on-screen alarm classification and handling

**Safety:** No derailments as a consequence of hot axle boxes, blocked brakes, load displacements and wheel failures since 2005, the beginning of operation of the **WTMS Monitoring Facility**



**Giuliano Montanaro, CEO**  
alius consulting GmbH  
Zürich, Switzerland