Wayside Train Monitoring Systems in Switzerland: no compromises on safety

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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.
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 …

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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

*In Switzerland the train is for everyone and for everything*

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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).

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

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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?

2. The aim of the project “Wayside monitoring”:

   9

   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

<table>
<thead>
<tr>
<th>Place</th>
<th>Country</th>
<th>km</th>
<th>In service since</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gotthard</td>
<td>Switzerland</td>
<td>57</td>
<td>2016</td>
</tr>
<tr>
<td>Seikan</td>
<td>Japan</td>
<td>54</td>
<td>1983</td>
</tr>
<tr>
<td>Channel</td>
<td>France-GB</td>
<td>50</td>
<td>1993</td>
</tr>
<tr>
<td>Lötschberg</td>
<td>Switzerland</td>
<td>35</td>
<td>2007</td>
</tr>
<tr>
<td>Guadarrama</td>
<td>Spain</td>
<td>28</td>
<td>2007</td>
</tr>
<tr>
<td>Taihang</td>
<td>China</td>
<td>28</td>
<td>2008</td>
</tr>
<tr>
<td>Hakkōda</td>
<td>Japan</td>
<td>26</td>
<td>2010</td>
</tr>
<tr>
<td>Iwate-Ichinohe</td>
<td>Japan</td>
<td>26</td>
<td>2002</td>
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<tr>
<td>Tianshan</td>
<td>China</td>
<td>22</td>
<td>2012</td>
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<tr>
<td>Dai-shimizu</td>
<td>Japan</td>
<td>22</td>
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<td>Wushaoling</td>
<td>China</td>
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<td>2006</td>
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<td>Lüliangshan</td>
<td>China</td>
<td>21</td>
<td>2011</td>
</tr>
<tr>
<td>Geumjeong</td>
<td>South-Corea</td>
<td>20</td>
<td>2010</td>
</tr>
<tr>
<td>Simplon</td>
<td>Switzerland -Italy</td>
<td>20</td>
<td>1905</td>
</tr>
<tr>
<td>Vereina</td>
<td>Switzerland</td>
<td>19</td>
<td>1999</td>
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</tbody>
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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
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)
2. The aim of the project “Wayside monitoring »: The Gotthard base Tunnel, 57km

- Multifunctional emergency stations
- ~ 60 km = equivalent to three 20 km tunnels

Wayside Train Monitoring Systems in Switzerland: no compromises on safety
2. The aim of the project “Wayside monitoring»: The Gotthard base Tunnel, 57km

Evacuation and rescue concept
2. The aim of the project “Wayside monitoring»:
The Gotthard base Tunnel, 57km

Maintenance door

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

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

the training and emergency center

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

simulation of accident and training
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
3. The reality of the daily operations

The big accident in the Simplon tunnel in 2011
3. The reality of the daily operations

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

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

- **Panto monitoring (availability)**
  - Uplift-measurement / optical monitoring
  - Prevention of problems in overhead traction lines

- **Fire and chemical detection (safety)**
  - Prevention of situations which are critical to safety as a result of fire or hazardous substance spillages

- **Magnetic field measurement (availability)**
  - Prevention of disruption to track-ahead free signals

- **Hot axle box and blocked brake detection (safety)**
  - Prevention of derailments due to broken axles and wheels

- **Nature hazards (safety)**
  - Prevention of collisions with material from rockfalls / landslides / avalanches

- **Wheel-load checkpoints (safety)**
  - Detection of load displacement and overloading
  - Serious wheel errors
  - Track-system burdens

- **WTMS network (safety, availability, case management)**
  - Central acquisition of all alarms and intervention process
  - Delivery of data to RU’s 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.
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
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.

[Image of completely destroyed axle box]
5. Prevention is better than cure: the Swiss WTMS – Wayside Train Monitoring Systems

Hot axle box and blocked brake detection
Critical incidents: blocked wheel.
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

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

critical incidents: load displacement 1:1.93.
5. Prevention is better than cure: the Swiss WTMS – Wayside Train Monitoring Systems

Detection of Flat wheels
to reduce noise / vibration / protect infrastructure.

- destroys infrastructure
- Leads to hot axle boxes

40 tons dynamic force!
5. Prevention is better than cure: the Swiss WTMS – Wayside Train Monitoring Systems

Profile and antenna localisation.

12 installations
200 alarms a year

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Wayside Train Monitoring Systems in Switzerland: no compromises on safety

- Uplift measurement
- Geology detection
- Fire and chemical detection
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Consistently networked WTMS.
A verifiable success story.

<table>
<thead>
<tr>
<th>Availability:</th>
<th>Potentially 300‘000 minutes of delays per year avoided via on-screen alarm classification and handling</th>
</tr>
</thead>
<tbody>
<tr>
<td>Safety:</td>
<td>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</td>
</tr>
</tbody>
</table>

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