NeTIRail

Needs Tailored Interoperable Railway Infrastructure

Tailoring of new overhead line installations to mechanical and electrical demands

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Tudor Popa, Lucian Anghel, Dorin Burețea

Analogic & Digital Systems

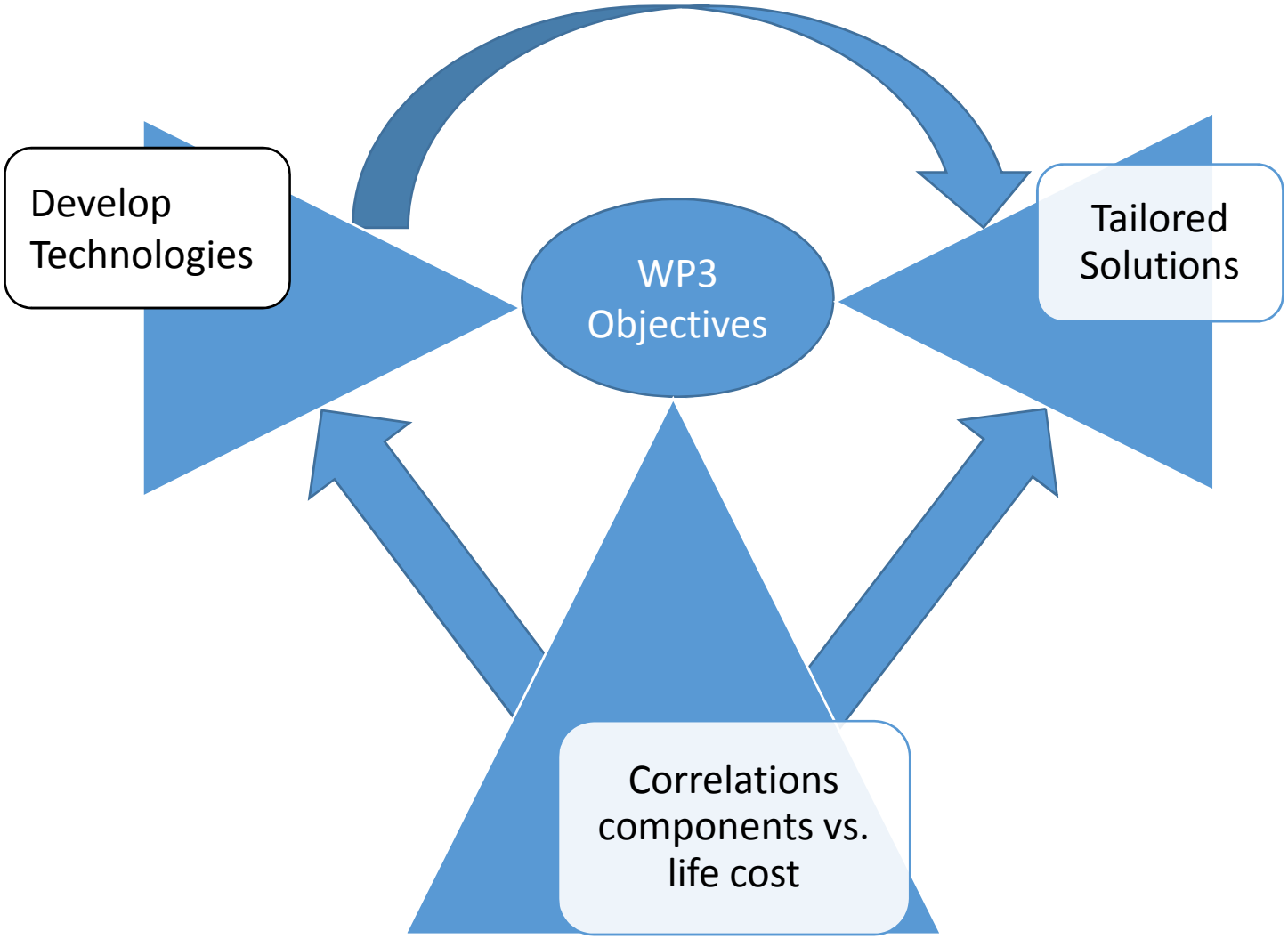
Content

- NeTIRail objectives
- WP3 Objectives
- WP3 Activities
- Support and Logistics
- Case study lines – electrified
- Overhead Contact Line System
- Pantograph and contact line
- Tailoring solutions
- Strategy of tailoring solutions
- Tailored solutions for new designs
- Tailoring solutions for maintenance

NeTIRail objectives

What NeTIRail want	• To support society by improving the productivity and economic viability of rail transportation.
How can do	• Propose solutions for tailoring the infrastructure to linking with the business and financial cases which provide finally benefit to society
Challenges	• NeTIRail-INFRA will develop and demonstrate technologies and best practice tailored to the needs of different categories of rail systems

WP3 Objectives



WP3 Activities (1)

Identified factors that influence the performance of power system failures:

- **Internal factors** – the grade and quality of the power system components
- **External factors** - environmental factors
- **GIS mapping techniques** are used - developed to reveal the drivers behind power system failures, and their dependence on the environment and the grade of overhead line, components

WP3 Activities (2)

Tailored solutions for overhead line power systems

- Addressing specially for new installations but also for existing power systems, where radical changes are possible
- Will avoid over-specification and provide optimal capability at lowest cost.
- Will develop modular packages of components and design specifications for the three line types: busy passenger, under utilized rural/secondary line, and freight dominated.

WP3 Activities (3)

Solutions for minimizing the life cycle costs

- Identifying and choosing of the controllable factors that can improve life of the overhead system for different traffic densities.
- These factors include wire tension, pantograph upload force, material of the pantograph collector strip, etc.
- Data acquisition about these factors using monitoring systems.
- Creating finite element models for optimization the controllable factors.

Support and Logistics (1)

New solutions will represent a step away than theory and documentation.

Physical systems, algorithms and mat models are created; these will be verified in laboratories and real field conditions.

The project brings together railway operators, infrastructure managers and research organisations to develop infrastructure tailored solutions.

Support and Logistics (2)

For increasing the efficiency, NeTIRail restraints the area of interest to the neglected specific railway line types: busy capacity limited passenger line, freight dominated route, rural or secondary and “low density” line

Testing stage will be conducted to support NeTIRail – WP3 objectives.

Support and Logistics (3)

Partners support and logistics for overhead line systems:

- Laboratories facilities support for testing of the designed systems and created models : USFD, TUDelft, AFER.

- Real field condition support and logistics: TCDD, TUDelft, SZ.

Support and Logistics (4)

Major gain of the project

- Identifying and bringing in the NeTIRail Project of the seven railway lines, with defined characteristics of the case studies.
- From the testing lines, five are electrified and will be the most important link chain of the development process.
- Tests will be realised in how many iterations is needed for increasing the functionalities, precision and reliability of the physical systems, algorithms and models.

Case study lines – electrified (1)

There are five lines:

- Turkey – TCDD and INTADER partners:
  - **Kayaş – Sincan** - busy passenger line;
  - **Malatya – İskenderun** - freight dominated route;
  - **Divriği – Malatya** - low density rural / secondary.
- Slovenia – SZ partner:
  - **Divača - Koper** - freight dominated route;
  - **Pivka - Ilirska Bistrica** - low density rural / secondary line.

Case study lines – electrified (2)

Necessity and possibility of modern technologies for designing new lines

Busy passenger line situation

- The modern and performance infrastructure is necessary to serve in good conditions the social demands.
- Expenses incurred are economic feasible and will be recovered from increasing of the passenger traffic.
- For existing radical changes lines, the cost needs to include potential modifications to structures and tunnels to allow electrical clearances between the structures and the high voltage overhead line.

Case study lines – electrified (3)

Freight category dominated route

- The investments will be recovered on the basis from covering the increasing transportation needs.

- Besides the increasing axle loads, for new lines and for those which accept radical changes, the designs should provide traction power supply capacity for heavy loaded trains.

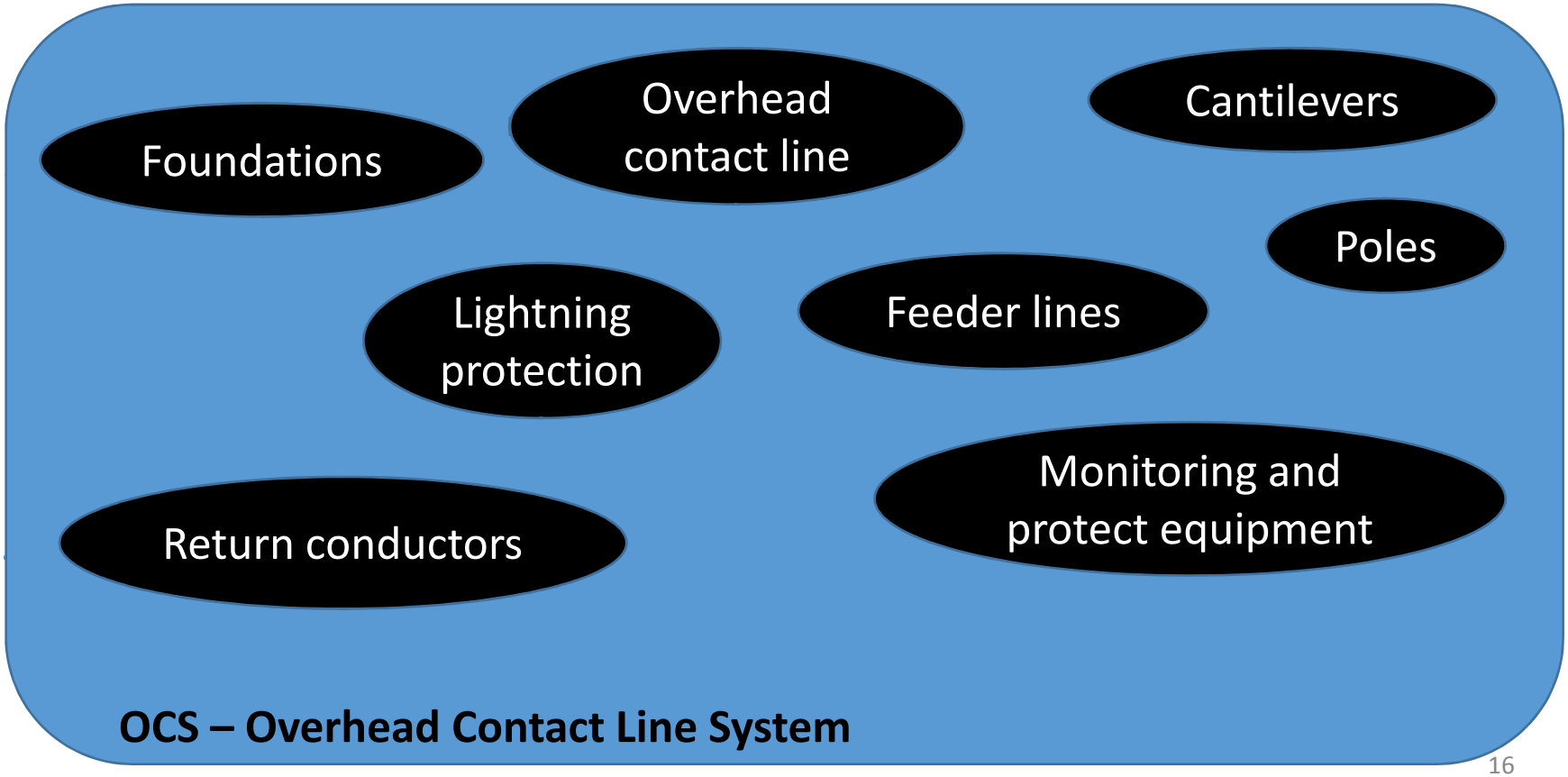
Case study lines – electrified (4)

Low density rural/ secondary line

- Represents a different situation.
- Investments into new lines may not be recovered.
- Increasing traffic density is mainly dependent on external factors.
- For existing lines, increasing efficiency could be possible through decreasing the maintenance cost; with this strategy, the line section will become more economic.
- Improvement technologies may provide effective returns and storage of energy from breaking recovery systems in combination with electrification infrastructures.

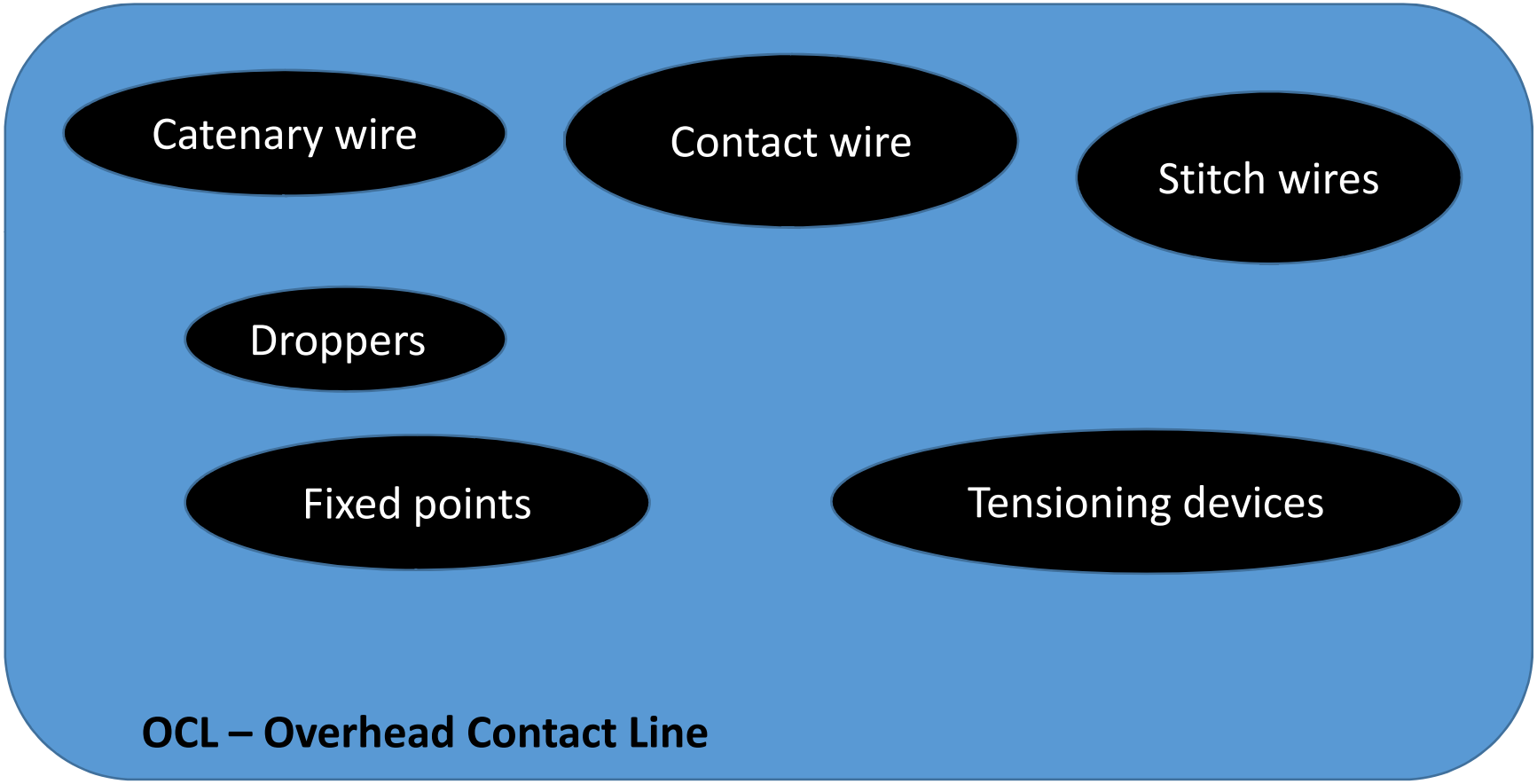
Overhead Contact Line System (1)

NeTIRail tailoring deals with the most important component of any railway power supply system: OCS - Overhead Contact Line System. Structured, OCS comprises:



Overhead Contact Line System (2)

Continuing in details, the overhead contact line (OCL) consists of:



Pantograph and contact line (1)

A special attention is granted to interaction of the pantograph and the overhead contact line

- The pantograph is the most important external component which influences the performance and the life cycle of the contact line system
- Collector strip has essentially duty of current collecting from traction power supply contact line system

Pantograph and contact line (2)

- WP 3 makes analyse of most performant models
- It is analysed and modelled the pantograph collector strip and the contact wire material as unitary mechanism.

Analysed factors related to panthograph:

- Contact force exerted by the pantograph on the contact wire
- Materials of which the collector strips and contact wires are made
- Number and the dimensions of the collector strips
- Current flowing through the contact point

Tailoring solutions (1)

- Grades and quality of the components have strong influence on the rate of failures and also against the life of the Power Supply System and are taken in consideration for tailoring to concrete situations
- Some components should be only performant to take place in the power supply system.

Tailoring solutions (2)

Other components provide contradictions for tailoring decisions

Ex.

- Droppers are subject to me-chanical loads from friction and bending during the passage of pantographs;
- The degree of wear increases with increasing stiffness of the dropper, which correspond with thicker wire cross sections.
- Solution means to provide thin cross section of wire, with more elasticity but,
- The second function of dropper is good current conducting, which requests thicker wire cross sections and reduction of dropper lengths.

Especially for these situations are needed physically and mathematically models to get optimisation.

Strategy of tailoring solutions (1)

NeTIRail applies the strategy of tailored solutions in several directions

1. Tailored solutions for designing new electric installations or for radical changes for conventional lines where is possible. Modular packages of components are considered specific to the case types of lines
2. Tailored maintenance for decreasing life cost of power supply usability. This concept could be expressed as “maintenance on request”.

Strategy of tailoring solutions (2)

NeTIRail provides data collecting systems, for the case study lines.

- The project provides many systems covering many aspects of railway infrastructures but also the rolling stocks.
- Three systems are dedicated to power supply systems:
  1. System for on-board monitoring of voltage, power spikes, other electrical properties;
  2. System to measure accelerations of overhead line;
  3. High speed video gathering data from contact point. Are measuring two aspects of controllable factors:
     - Displacement of the contact line, under contact force.
     - Registering of the intensity and density of the electrical arcs; they reflect the quality of the contact current collector.

Strategy of tailoring solutions (3)

NeTIRail provides finite element models:

- to explore the relationship between controllable factors and power system increasing quality.
- data achieved by the collecting systems become inputs for the modelling process.
- the models will be used to tailor components and equipment specifications for each of the line types considered.

Tailored solutions for new designs (1)

When designing new power supply systems, tailoring means selecting components and technologies will be used:

- selection of the overhead contact line design;
- selection of conductor cross sections and tensile forces;
- selection of span lengths;
- selection of system height;
- design of contact lines in tunnels;
- adoption of contact wire pre-sag;
- selection of dropper spacing;
- using or not of a stitch wire;
- selection of tensioning section length.

Tailored solutions for new designs (2)

Restrictions from environmental influencing factors

- Considering lifetime operation, overhead lines are subjected to electrical and mechanical loads resulting from climatic environment; this has a major influence on overhead line system
- The WP3 provides models to support increasing the resilience of power supply systems to changing climate
- Next factors are subject for models of external influencing factors : ambient temperature, wind velocity and wind loads, icing and ice loads, lightning strokes, industrial pollution, etc.

Tailoring solutions for maintenance (1)

Investments for new lines should continue with adequate maintenance to keep low the life cost of the system.

Inspection activities are the first step in establishing the needed maintenance. If these checks are accurate, it can intervene only at times when needed.

Maintenance and inspection activities are becoming increasingly importance with increasing travel speed on railway networks.

Large volume of data will be collected for decision of maintenance

Tailoring solutions for maintenance (2)

Modern strategies fit the inspection functions to the trains used for commercial service; measurements can be performed during normal operation.

The monitoring systems provided could be used for long time collecting data and upgrading models

Parameters to inspect for overhead contact line:

- Wear grade of contact line
- Longitudinal deviation of contact line;
- Transversal height deviation of contact line

Thank you!