NeTIRail

Needs Tailored Interoperable Railway Infrastructure

Economic impact of innovations (WP1)

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Introduction & motivation

- A recognised **challenge in the railway** industry: understanding engineering processes in economic terms (rail consortium in Leeds, January 2018).
- Technological innovations can **improve efficiency**
- Technical leaps may be very **costly**
- Necessary to provide both a **financial rationale** (for the infrastructure provider) as well as a **wider economic argument** for large investments
- WP1 key aim: a **Cost-Benefit Analysis of the NeTIRail innovations**

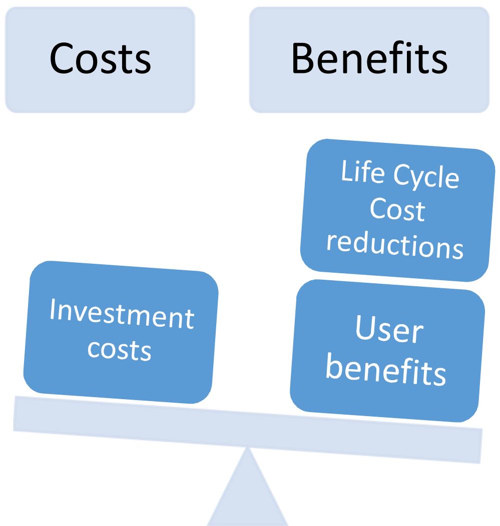
Aims and challenges

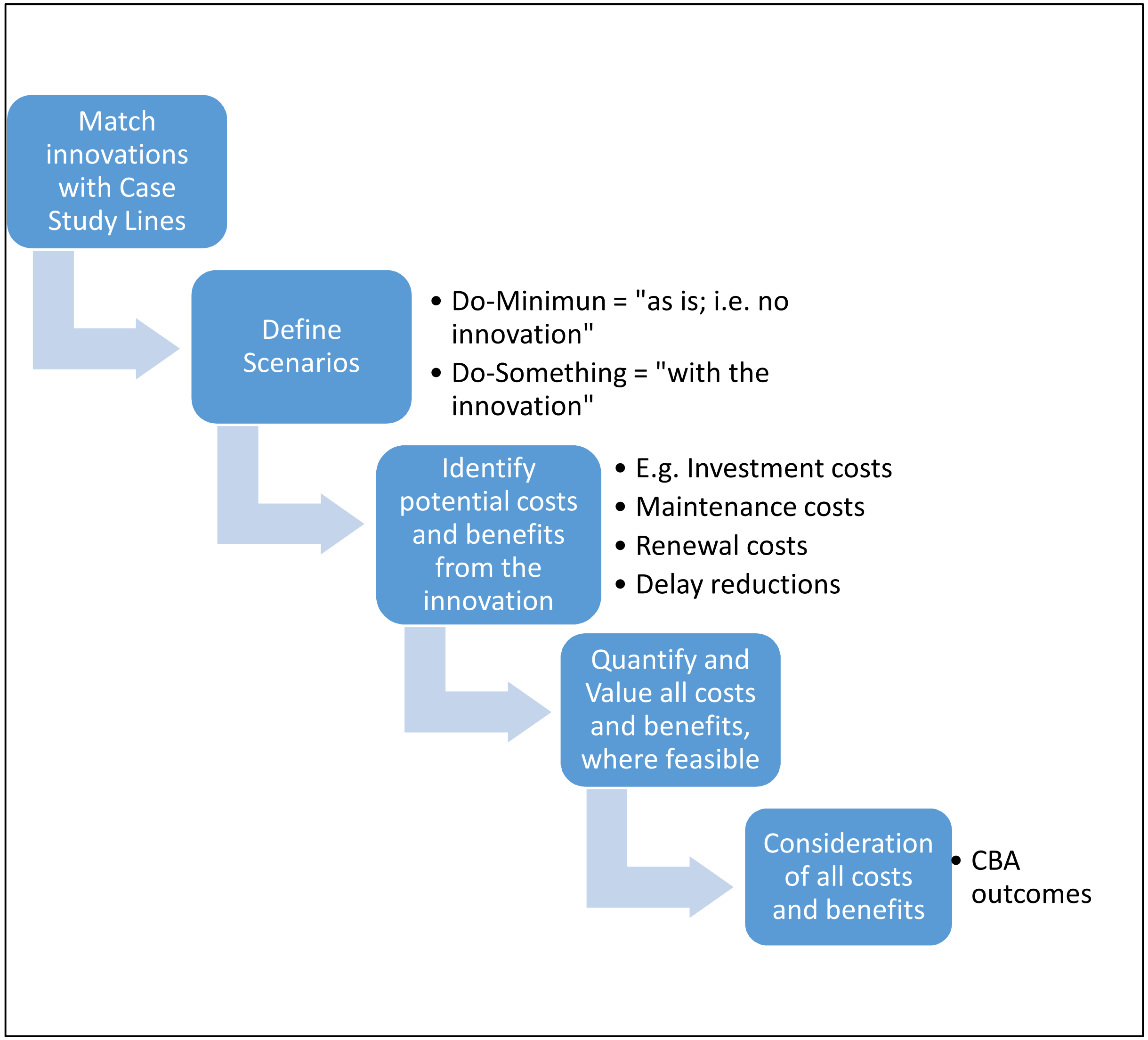
- **CBA** is a widely used tool to assess the economic impact of transport projects and policies
- Applied to a range of railway infrastructure engineering innovations
- ...not the most common field of application
- Major challenge: to establish that the alternative is even more costly
- Without appropriate **information**, there is a risk that resources are spent on research on technical improvements that would be too costly to implement
- Difficulties to obtain reliable data/information.

Methodology

Cost-Benefit Analysis

Simplifying…





Methodology

Cost-Benefit Analysis – Output table example

		Costs and Benefits output table			
		Innovation 1		**Innovation 2**	
		Time horizon=10 years ; @3% discount		Time horizon=10 years ; @3% discount	
Costs (by stakeholder)					
Infrastructure Manager					
Capital investment costs					
Maintenance costs					
Other costs					
Total Costs					
Benefits (by stakeholder)		Sensitivity scenario 1	Sensitivity scenario 2	Sensitivity scenario 1	Sensitivity scenario 2
Infrastructure Manager					
Life cycle cost (LCC) savings (M&R)					
Increased track availability					
Total benefits for IM					
Rail users					
Delay reductions					
Safety risk reductions					
Comfort improvement					
Total benefits for rail users					
Total benefits					
Social CBA outputs					
Net Present Value (NPV)					

Summary of CBA outcomes (I)

WP2 innovations – Summary table (Part 1)

	Innovation	Case study	Investment Cost	CBA summary	Additional, non-monetized benefits
1a	2.3a: **Lean techniques for S&C** (off-site assembly)	Turkish railway network	**Zero cost**: managerial changes	NPV = €2.4M over 30 years, if applied to 375 switches/year. (€4.8M for 750 switches*). Most benefits arise from **higher productivity**. The NPV is hence highly proportional to labour costs. *A total of 750 switches are replaced every year.	187 yearly shifts of track **availability** across the whole network (1/4 of all switches replacements)
1b	2.3b: **Lean techniques for S&C** (trackside assembly)	Turkish railway network	Zero cost: managerial changes	NPV = €2.9M over 30 years, if applied to 375 switches/year. (€5.8M for 750 switches). The NPV is highly proportional to labour costs.	375 yearly shifts of track availability across the whole network (1/2 of all switches replacements)
2	2.4: Choice between different **fastening systems**	Swedish railway network	Unknown. To be calculated as = **Fast clip cost** minus E-clip cost	**Maximum Net Present Benefits** (NPB) = **€10.7 million over 25 years** for the average track section (70,200 meters). **NPV > 0 if the switch to Fast-clip costs less than an extra €153 per meter**	• Increased track **availability** (if less grinding needed). • **Reduced delays** (if fewer failures) • **Reduced noise** for households near tracks.

Summary of CBA outcomes (II)

WP2 innovations – Summary table (Part 2)

	Innovation	Case study	Investment Cost	CBA summary	Additional, non-monetized benefits
3	2.5: **On-board lubrication techniques**	Divača – Koper; Slovenia (freight line)	**€2,443 per locomotive/per year**	NPV = €208k over 30 years, for 1 route with 1 equipped train, **relative to no lubrication**. **BCR = 4.68**	• **Reduced delays** • Improved **safety** • **Reduced pollution**
4	2.6: **Heavier sleepers for transition zones**	Swedish railway network	Unknown	**Maximum Net Present Benefit** (NPB) = **€59,553 per transition zone over 25 years** (i.e. €119,106 per bridge or tunnel). NPV > 0 if transition zone can be upgraded for less than €59,553	• **Reduced delays** (fewer failures) • Improved **safety** (fewer failures)

Summary of CBA outcomes (III)

WP3 innovations – Summary table

	Innovation	Case study	Investment Cost	CBA summary	Additional, non-monetized benefits
5	3.4a: **Trolley wire model for overhead lines** (instead of Catenary Wire model)	Bartolomeu-Zarnesti ; Romania (secondary line)	€12.2M (instead of €26.1M of the traditional Catenary Wire model based on costs from Great Britain)	NPV > 0 provided that ongoing maintenance costs are less than €702k/year (for comparison, data from Great Britain shows that ongoing maintenance costs for the Catenary wire model costs are €117k/year).	• Longer travel times (speed limit of 80km/h instead of 120km/h). For this line, the limit is 80km/h anyway, so no time loss in the short term.
6	3.4b: **On-board overhead lines monitoring**	Generic analysis at route level (applicable to any electrified line)	**€1,500 every 5 years**	NPV > 0 if benefits (e.g. life cycle cost savings) are at least €279 per year.	• **Reduced delays** (fewer failures) • Improved **safety** (fewer failures) • Increased track **availability**

Summary of CBA outcomes (IV)

WP4 innovations – Summary table

	Innovation	Case study	Investment Cost	CBA summary	Additional, non-monetized benefits
7	4.1: **On-track monitoring of turnouts S&C sections**	Bartolomeu-Zărneşti ; Romania (secondary line)	Approx. €15,000 every 3 years + €4,500 running costs. **Depends on the line characteristics** (& number of turnouts and S&C.	**NPV > 0 if benefits** (e.g. life cycle cost savings) **are at least €7.5k per year.** Judgement: NPV would be higher in lines with severe corrective maintenance problems and busier lines.	• **Reduced delays** (fewer failures) • Improved **safety** (fewer failures)
8	4.2: **Axle box acceleration (ABA), on-train monitoring system.**	Generic analysis at route level (applicable to any line)	**€100k investment** every 10 years. **+** Approx. **€5,000/year** in maintenance and running costs	**NPV > 0 if benefits** (e.g. life cycle cost savings) **are at least €16.6k per year.** Judgement: NPV would be higher in lines with severe corrective maintenance problems and busier lines.	• **Reduced delays** (fewer failures) • Improved **safety** (fewer failures)
9	4.3: **Smartphones, on-train monitoring system.**	Generic analysis at route level (applicable to any line)	Approx. **€3k/year** (no upfront extra investment)	**NPV > 0 if benefits** (e.g. life cycle cost savings) **are at least €3k per year.** Judgement: NPV higher in busier lines & with severe corrective maintenance problems.	• **Reduced delays** (fewer failures) • Improved **safety** (fewer failures) • Potential to allow for improved **comfort**

Synthesis of Cost-Benefit Analyses

- Technologies can **save** money AND **improve** quality (assets/service)
- Understanding the status quo is crucial – how costly is it now?
- Low or even no upfront investments may be needed (affordability)
- Technologies that **unlock** possibilities: e.g. monitoring devices – what is the value of information?
- Help to switch to **more preventive** practices (less corrective M&R)
- Some can **benefit all**: IMs, operators and users (delays, safety…).
- Further research needed to **improve decision-making**: the economics of some aspects not well understood (e.g. transition zones).

Deliverables (references)

- NeTIRaiL-INFRA Deliverable D1.1. Report on selection of case studies.
- NeTIRaiL-INFRA Deliverable D1.2. Database of economic data on case study lines
- NeTIRaiL-INFRA Deliverable D1.3: Cost model development report
- **NeTIRaiL-INFRA Deliverable D1.4. Cost and User Benefits report**
- NeTIRaiL-INFRA Deliverable D1.5: Wider economic benefits intermediate report
- NeTIRaiL-INFRA Deliverable D1.6: Wider economic benefits final report
- NeTIRaiL-INFRA Deliverable D1.7: Incentives final report
- **NeTIRaiL-INFRA Deliverable D1.8: Final Business Case Synthesis Report**
- NeTIRaiL-INFRA Deliverable D5.2. Perception of different service options: User study and data analysis.
- NeTIRaiL-INFRA Deliverable D5.3: Balancing societal effects and cost-benefit of different infrastructure decisions

Thanks!