



Gruppo FS

The Mobility Leader

The social impact of High-Speed Rail from consolidated frameworks to innovative references and tools

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Gruppo FS

Research Centre



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1.1 Research Question

Mandatory and voluntary assessments

Mandatory legislative frameworks



National Procurement Code

- Sustainability Report
- Cost – Benefit Analysis
- Multicriteria Analysis for Design Alternatives
- Public debate

Voluntary protocols and methodologies



Sustainability ratings

Stakeholder engagement

Life Cycle Sustainability Assessment (LCSA)



Strategic projects including HSR

Ex. **The Envision framework is an internationally recognized sustainability rating system** for civil infrastructure projects, including social indicators, in particular within the Quality of life and Leadership pillars.

Social Acceptance enriches **Sustainability studies and support public debate** with citizens and local authorities

Social LCA represent an opportunity for the supply chain studies

1.2 Objectives

A methodological framework for the social impact assessment approaches

The paper aims to critically **review and compare existing social impact assessment approaches** for high-speed rail projects, with the objective of exploring potential integrations and synergies among assessment models, contributing to a **more coherent and operationally applicable methodological framework**.

The study focuses on the three assessment models relevant for infrastructures:

Traditional transport and sustainability indicators for social impacts

Social Acceptance

Social LCA

The study has elaborated a solid methodology in order to build a methodological framework characterised by:

- completeness
- scientific robustness
- data availability
- comparability
- operational applicability

2. Literature background

Regulations, guidelines, standards and academic papers

Traditional transport and sustainability indicators for social impacts

- C. Zapounidis, P. M. Pardalos, **“Handbook of Multicriteria Analysis”**, Springer 2010.
- Agenzia per la Coesione Territoriale, **“Guida all’analisi costi-benefici dei progetti d’investimento”**, 2014.
- ISTAT, **“Rapporto SDGs 2024. Informazioni statistiche per l’Agenda 2030 in Italia”**.
- MIMS, **“Linee guida per la redazione del Progetto di fattibilità tecnica ed economica da porre a base dell’affidamento di contratti pubblici di lavori del PNRR e del PNC”**, 2021.

Social Acceptance

- Geraint Ellis, Senni Maatta, **“Social acceptance research guide”**, Mistral innovative training network 2022
- Mariana Galvão Lyra, **“Social Acceptance”** in Elgar Encyclopedia of Innovation Management, 2025.
- JRC, **“Societal aspects of transport in research and innovation in Europe”**, 2026.

Social LCA

- UNEP Guidelines 2020
- UNI ISO 14075; ISO 14040
- Ayassamy P., Pellerin R., **“Social Life-Cycle Assessment in the Construction Industry: A Review of Characteristics, Limitations, and Challenges of S-LCA through Case Studies”**, Sustainability 2023.
- Backes J. G., Traverso M., **“Social life cycle assessment in the construction industry: systematic literature review and identification of relevant social indicators for carbon reinforced concrete”** Environment, Development and Sustainability, 2024.

3. Research Design

3.1 Methodology



Goal and scope

1

- Brief definition
- Objective of the methodology (e.g., decision support, reporting)
- Scope of application (e.g., project phases, etc.)



Reference

2

- Regulations and guidelines
- Scientific and methodological references and institutional reports



Topics & KPI

3

- Key topics, identifying stakeholders (e.g., workers, communities, users, supply chain, etc.) and social issues (e.g., human rights, health and safety, employment, inclusion) analyzed.
- Types of KPIs (qualitative, quantitative)



Strengths and weakness

4

- Innovation and effectiveness (e.g., ability to quantify impact, coverage of life cycle phases, usefulness for decision-making, stakeholder engagement)
- Shortcomings and critical issues (e.g., high methodological complexity, strong data dependence, subjectivity in indicator selection, difficulty with standardization)

3.1 Methodology

Traditional transport and sustainability indicators for social impacts



Goal and scope

1

- **Brief definition:** To assess the social impacts of infrastructure projects, different **sustainability indicators** (technical-economical, environmental and social) are used, applying consolidated (mainly quantitative) methodologies in accordance with the type of analysis and project being evaluated. Data sources are related to experts studies.
- **Objective:** The goal is to **support strategic and operational decisions in the planning and design processes** by promoting choices that maximize social benefits in terms of accessibility, mobility rights and territorial cohesion.
- **Scope:** The scope of the application is the **Multi-Criteria Analysis** – to compare different design alternatives during the **pre-feasibility phase** – considering both short/mid-term (construction phase) and long-term (fully operation phase) effects, with the aim to evaluate the **entire project lifecycle**.



Reference

2

- Guidelines and EU references help to define topics and indicators of the performance matrix, and for each project typology, a **specific evaluation framework** is selected.
- **Guidelines and references:**
 - MIMS, “Linee guida per la redazione del Progetto di fattibilità tecnica ed economica da porre a base dell’affidamento di contratti pubblici di lavori del PNRR e del PNC”, 2021.
 - C. Zapounidis, P. M. Pardalos, “Handbook of Multicriteria Analysis”, Springer 2010.

3.1 Methodology

Traditional transport and sustainability indicators for social impacts



Topics & KPI

3

- **Key topics** relate to the impact of infrastructure on the **territory and communities**, but the list of KPIs (and the associated topics) can change depending on the analyzed project.
- List of the most commonly used **KPIs** (non-exhaustive):

TOPICS	KPIs	LIFE CYCLE PHASES	
		CONSTRUCTION	OPERATIONS
Equity and integration of railway network	the role of infrastructure in passenger mobility flows		X
	the project's contribution to an integrated and intermodal transport system		X
	equitable and inclusive access to rail services		X
	human capital mobility for innovation and territorial development		X
	developing sustainable goods transport		X
Noise impact	the noise's significance in the territory		X
	people's exposure to noise		X
	reduction of railway noise pollution		X
Save time on journeys	save time on rail journeys		X
	save time on road journeys		X
Relationship infrastructure/built environment	urban and anthropogenic reconnection		X
	criticism of expropriation	X	
	per capita land use	X	
	railway-related interruptions	X	
	the economic impact of infrastructure investment	X	
	sustainable access to and enhancement of the territorial heritage		X
Infrastructure safety, efficiency and resilience	improving railway infrastructure safety		X
	improving the infrastructure's resilience		X
	development of technological systems to improve rail traffic efficiency		X



Strengths and
weakness

4

- **Strengths:** The KPIs properly assess some topics and help to compare design alternatives, considering trade-off solutions between the multidisciplinary criteria considered simultaneously (even when they conflict with each other).
- **Weakness:** In the feasibility design phase, one weakness lies in the assessment of long-term indicators, given the uncertainty caused by the low availability of data; however, the assessment should extend to long-term effects, taking into account all stages of the life cycle (e.g. end-of-life).

3.1 Methodology

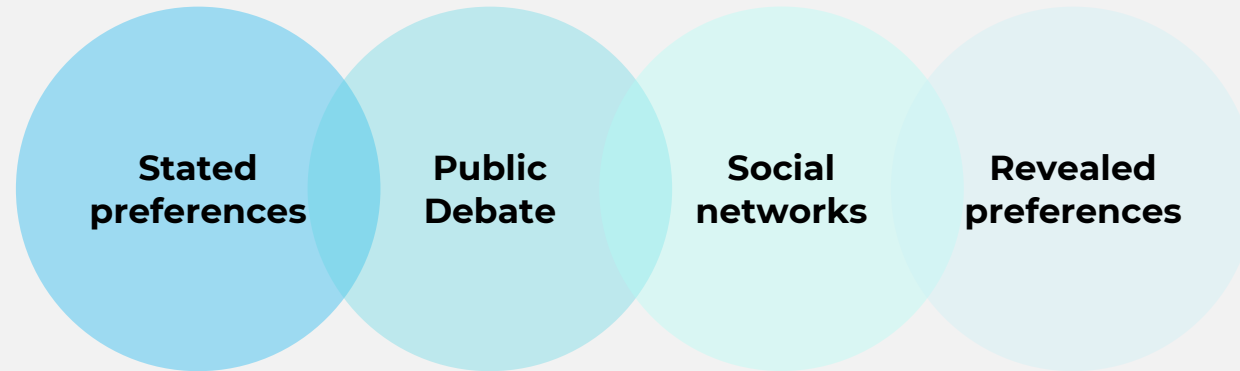
Social Acceptance



Goal and scope

1

- **Brief definition:** Social acceptance analysis in transport projects evaluates **how communities perceive, adopt, and interact with new mobility solutions.**
- **Objective:** To collect the sentiment of stakeholders, prevent conflicts in construction phase and develop synergies to achieve common benefits.
- **Scope:** This methodology is usually implemented **in strategic infrastructure projects with major impact on communities, including HSR and mass transit** in order to support decision making and enable the stakeholder engagement of communities and users along the design process.



Reference

2

- Social acceptance **literature review is very developed in energy field but limited in transport topics and HSR**
- **Main Guidelines:**
 - . Geraint Ellis, Senni Maatta, Social acceptance research guide, Mistral innovative training network 2022
 - . Mariana Galvão Lyra (2025), «Social Acceptance» in Elgar Encyclopedia of Innovation Management.

3.1 Methodology

Social Acceptance



Topics & KPI

3

- **Key topics** relate to **economic costs**, environmental impacts, social issues mainly including risks and safety but can include other topics.
- The literature review relate to mainly related to communities, local authorities and users/market.
- Positive , negative o neutral sentiment



Strengths and weakness

4

- **Strenghts:** The use of digital tools and Artificial Intelligence enable the expansion of the study scope and study sample.
- **Weaknsses:** Very few research and practices in the transport field

Topic	Indicator
LANDSCAPE HERITAGE AND REDEVELOPMENT	Interference with areas subject to landscape constraints
	Interference with areas of historic, archaeological and cultural interest
	Landscape redevelopment and territorial reconnection measures
	Enhancement measures for areas of historic interest
EFFECTS ON THE TRANSPORT SYSTEM AND SAFETY	Time savings
	Change in operating costs of private vehicles
	Change in urban congestion
	Change in accident rates
EFFECTS ON CONNECTIONS AND RELATION WITH THE TERRITORY	Change in annual bicycle travel
	Strategic importance of the infrastructure
	Service index
	Usability of Stations/Stops and relationship with the city
USABILITY AND ENHANCEMENT OF THE TERRITORY	Development of new cycle routes
	Development of upgraded cycling-pedestrian routes
	Territorial fragmentation index
	Safety of public spaces near stations/stops
	Tourism usability of the territory
	Accessible recreational and sports points
	Accessible historical-cultural points
	Food and wine attraction points
QUALITY OF LIFE AND URBAN ENVIRONMENT	Number and scale of enhancement interventions on buildings in the territory
	Number and scale of enhancement interventions on public areas
	Disruption to the community during construction
	Interference with the built environment
	Fragmentation of territories
	Buildings with reduced accessibility
	Visual obstruction
	Visual intrusions
	Intersections with infrastructure axes
	New works for railway crossing
	Effects on perceived safety

3.1 Methodology

Social LCA



Goal and scope

1

- **Brief definition:** S-LCA is a methodology for evaluating the social and socio-economic impacts of products and services throughout their life cycle.
- **Objective of the methodology:** Examples of possible objectives are: Support sustainable design; Support human rights due diligence; Identify key social hotspots; Quantify and qualify potential social performance and communicate it to the public; Examine potential social improvement options throughout the life cycle; Evaluate the most relevant stages of the social value chain in terms of social impacts/hotspots; Understand whether the product value chain contributes to the social development of its stakeholders.
- **Scope of application** (linked to the study objective):
 - Complete life cycle of products and services (cradle to grave, from resource extraction to end-of-life)
 - Product supply chain (cradle to gate, excluding use and end-of-life)
 - Parts of the life cycle (e.g. gate to gate or gate to grave)



Reference

2

- **Regulations and guidelines:** UNI ISO 14075, ISO 14040, UNEP Guidelines 2020
- **Scientific and methodological references and institutional reports**



3.1 Methodology

Social LCA



Topics & KPI

3

- **Key topics**, identifying stakeholders and social issues analyzed
- **Types of KPIs**: qualitative and quantitative



Strengths and weakness

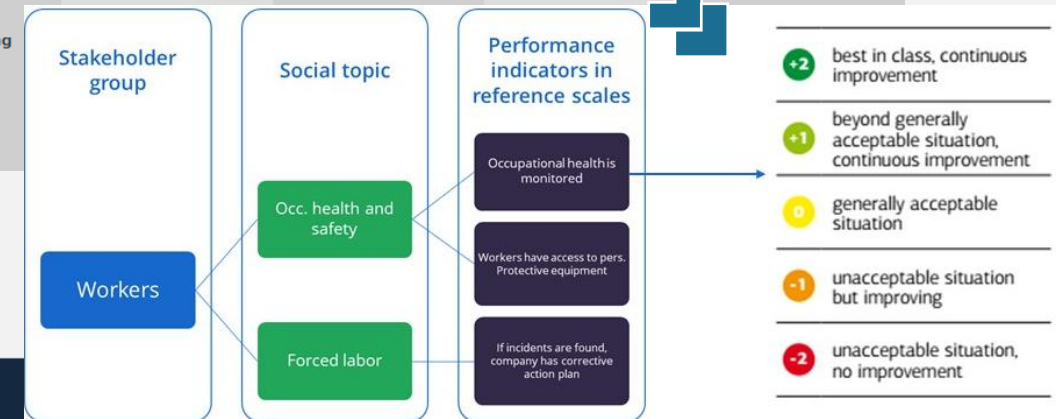
4

- **Innovation and effectiveness**: coverage of life cycle phases, ability to individuate risk areas, usefulness for communication, assessment of supply chain
- **Critical issues**: methodological complexity, data availability dependence, subjectivity in indicators and baseline selection, difficulty with standardization

Stakeholder categories	Worker	Local community	Value chain actors (not including consumers)	Consumer	Society	Children
Subcategories	1. Freedom of association and collective bargaining 2. Child labor 3. Fair salary 4. Working hours 5. Forced labor 6. Equal opportunities/discrimination 7. Health and safety 8. Social benefits/social security 9. Employment relationship 10. Sexual harassment 11. Smallholders including farmers	1. Access to material resources 2. Access to immaterial resources 3. Delocalization and migration 4. Cultural heritage 5. Safe and healthy living conditions 6. Respect of indigenous rights 7. Community engagement 8. Local employment 9. Secure living conditions	1. Fair competition 2. Promoting social responsibility 3. Supplier relationships 4. Respect of intellectual property rights 5. Wealth distribution	1. Health and safety 2. Feedback mechanism 3. Consumer privacy 4. Transparency 5. End-of-life responsibility	1. Public commitments to sustainability issues 2. Contribution to economic development 3. Prevention and mitigation of armed conflicts 4. Technology development 5. Corruption 6. Ethical treatment of animals 7. Poverty alleviation	1. Education provided in the local community 2. Health issues for children as consumers 3. Children concerns regarding marketing practices

Source: UNEP Guidelines 2020

Source: SlmaPro



8-9th September 2026

6th International Symposium on High-Speed Rail Socioeconomic Impacts
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Chiara Ravagnan

3.2 Results

Synergies and relevance for HSR planning and upgrading

PILLARS	INDICATORS																	
	Traditional transport and sustainability indicators for social impacts						Social Acceptance							Social LCA				
	Mining and processing	Manufacturing	Construction/ installation	Use	Maintenance	End of Life	Mining and processing	Manufacturing	Construction/ installation	Use	Maintenance	End of Life	Mining and processing	Manufacturing	Construction/ installation	Use	Maintenance	End of Life
Health and Safety				X	X					X			X	X	X	X	X	X
Life quality and territorial conditions			X	X					X	X			X	X	X	X	X	X
Social Inclusion				X						X			X	X	X	X	X	X
Labor Conditions													X	X	X	X	X	X
Impact on local employment and economy and capacity building			X	X					X				X	X	X	X	X	X
Territorial identity and cultural heritage and landscape				X					X				X					
Compliance, accountability, transparency and stakeholder engagement													X	X	X	X	X	X
Technology transfer, research and innovation			X	X					X	X			X	X	X	X	X	X

Traditional indicators and Social Acceptance approaches cover only select pillars, focusing exclusively on the construction and use phases, while the social LCA represents the most comprehensive approach to the analysis of the entire life cycle.

3.2 Results

Synergies and relevance for HSR planning and upgrading

ASSESSMENT MODELS	DESIGN PHASES			
	Design Alternatives Analysis	Technical and Economic Feasibility Design	Tender Procedure	Detailed Design / Construction Supervision
Traditional transport and sustainability indicators for social impacts	Quantitative indicators in Multi-Criteria Analysis to compare Design Alternatives	Quali/quantitative indicators to highlight project's positive outcomes for people and territory		TBD: Monitoring of social impacts indicators in construction phase.
Social Acceptance	Qualitative assessment in relation to social topics from the community and local authorities during the Public Debate collected in the final report.	Quantitative assessment of the public opinion related to the project from the Social Web Monitoring, with highlights on the key issues to be considered during the procedural process.		TBD: Quantitative assessment of the public opinion related to construction from the Social Web Monitoring, with highlights on the key issues to be considered during the procedural process.
		Qualitative assessment of the public opinion related to the project from the Sentiment Analysis, with highlights on the key issues to be considered during the procedural process.		TBD: Qualitative assessment of the public opinion related to the construction from the Sentiment Analysis, with highlights on the key issues to be considered during the procedural process.
Social LCA*	TBD: Qualitative and quantitative assessment to compare the social impacts of design and construction approaches associated with different supply chains (e.g. use of different materials, processes involving different manufacturing methods, etc).	TBD: Qualitative and quantitative assessment to estimate the social impacts generated throughout the life cycle of the project and related supply chain.	TBD: Qualitative and quantitative assessment used as a reward criteria for tenderers that assess their social impacts.	TBD: Qualitative and quantitative indicators to monitor contractors' operations and conduct.
			TBD: Qualitative and quantitative assessment used as a reward criteria to select the product/service with the lowest social impact.	

*the application of this methodology to infrastructural projects is still under development.

TBD: activities to be defined.

4. Final Summary: Conclusions and future developments

Opportunities, limits and next steps

- The **three approaches have different application in FS practices** from the traditional KPI (consolidated in transport studies and design practices assessments) to social acceptance (implemented in strategic projects) until social LCA (only experimented in research projects).
- The approaches and tools **have been truly affected by digitalization** processes that reshapes methodologies and potential scopes of studies.
- Next research steps can deepen the potential **interoperability of data following the synergies of methodologies** developed in this study combining innovation in sustainability with digitalization.

Strenghts and weaknesses



Monitoring in **Construction phase** could be implemented for social impact, integrating the three approaches.



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Thank you

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