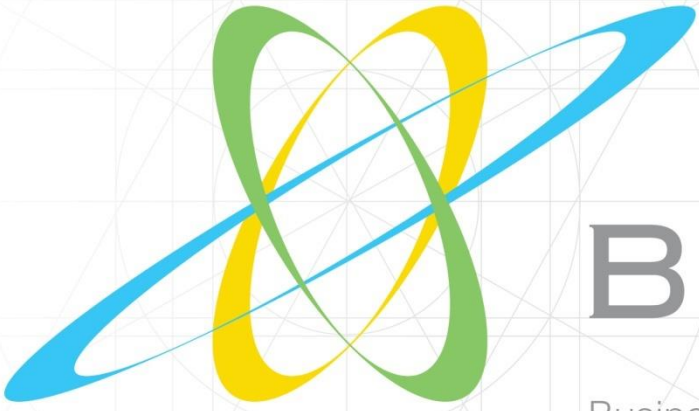

BENEFIT

Business Models for Enhancing Funding
& Enabling Financing for Infrastructure in Transport

Deliverable: D 5.3 – Policy Guidelines and Recommendations

European Commission

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Grant Agreement No.: 635973

Deliverable: D 5.3 – Policy Guidelines and Recommendations

Project Start Date: December 1st 2014 **End Date:** September 30th 2016

Co-ordinator:	University of the Aegean (UAEGEAN)
Deliverable No	D 5.3
WP	5
Task	5.3
Task Leader	UAEGEAN
Work package Leader	IST
Due date:	30/09/2016
Submission date:	30/09/2016

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Glossary

Within BENEFIT certain terms are used throughout. These are described here.

Public Private Partnership(s): Notwithstanding existing formal definitions of this procurement/delivery model, in the BENEFIT project a Public Private Partnership is considered a project (of public interest) receiving private (co)financing, under a contract that bundles at least construction and operation. The contract may include the allocation/transfer of certain project risk(s).

Funding Scheme: A funding scheme is considered to be any combination of private and public income generated by or towards the infrastructure over its life cycle. These may include any combination of user contributions (tolls, fees, fares etc.) or public contributions based on direct and indirect taxation etc. Public funding may also take on the form of availability fees, shadow tolls etc.

Financing Scheme: A financing scheme is considered to be any combination of public and/or private financial investments or instruments (e.g. guarantees) required by the infrastructure project over its life cycle.

Business Model: The business model describes the business case of the overall investment in the project. Depending on the context, it may be narrowed, including merely the service(s) of the infrastructure project(s) considered, or it may be widened, including other planned and commonly designed activities which aim to capture other "planning gains" (and other value-adding services) and/or exploit synergies across different sectors (e.g. transport, energy, ICT). These synergies are a direct reference to the concept of innovative procurement and other novel approaches to infrastructure delivery, now in the pilot phase.

Key Elements: Elements are groups of contextual variables which influence the performance of the funding scheme and financing scheme of a transport infrastructure project. Elements, as noted in Figure 1.1.1 [of the proposal/contract], are the implementation environment (socio-political, micro- and macro-economic, institutional, regulatory, etc.); the transport mode (functionality; natural and contractual exclusivity, etc.); business model structure; funding scheme; financing scheme and governance and institutional arrangement (risk allocation; decision making processes; ownership rights, etc.).

Typology: A typology is a group of factors that aims to describe the characteristics of Key Elements (see above definition). These factors are defined, developed and quantified through the use of relevant Indicators (see definition below) in order to capture particular project behaviour. Example: A negative private investment environment can be captured by factors within the implementation context typology. The group of factors leading to the demonstration of this behaviour may consist of: poor growth forecast, lack of enabling legal framework etc. Typologies have been generated for every element (context) that has been found to influence transport infrastructure projects by leveraging empirical information from the collective BENEFIT database (country profiles and project cases) through field and desk research. Typologies and their underlying Indicators have been based on quantitative and qualitative analysis.

Decision Matching Framework: This is the Analysis and Decision Framework that has been developed by the BENEFIT project. The framework contains typologies influencing the overall performance of a project. The Matching Framework describes the system of infrastructure delivery.

Transport Infrastructure Resilience Indicator: Is a new proposed indicator measuring the ability of a Transport Infrastructure project to withstand, adjust and recover from changes within its structural and implementation elements with respect to its ability to deliver specific outcomes (such as cost and time to completion, expected traffic and expected revenue targets). The Transport Infrastructure Resilience Indicator is linked to an underlying rating system whose categories reflect the likelihood of achieving pre-specified target outcomes and express the level of vulnerability of the project to external adverse implementation conditions and internal structuring weaknesses.

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Indicators: The BENEFIT Matching Framework typologies are expressed through indicators which take values in the range [0, 1]. As indicators tend to the value 1, they represent a project structure that has less risk and lower cost to the project. The indicators used within BENEFIT are described below:

*The **Financial Economic Indicator*** measures more than just the macro-economic and macro-financial context of a country, but more broadly the *business environment* and can be seen as a proxy of *the level of productivity of a country*. The Global Competitiveness Index of the World Economic Forum was selected to describe this indicator. Therefore, "*good* financial economic conditions" in this context correspond to a high level of productivity.

*The **Institutional Indicator*** refers to political, regulatory and administrative factors ranging related to political stability and capacity, as well as absence of corruption; legal and regulatory framework (in terms of rule of law, regulatory quality), including the liberalization of transport market regulations; and public sector capacity as measured by government effectiveness. For most of these factors, relevant governance indicators of the World Bank Governance Indicator (WGI) are used, besides the OECD ECTR indicators regarding transport. Therefore, "*good or strong* institutional context" corresponds to stable institutional conditions of high quality reflecting government effectiveness.

*The **Cost Saving Indicator*** is a composite indicator including: Ability to construct (Level of civil works/ technical difficulty; Capability to construct; Construction risk allocation as per contractual agreement; Assessment of optimal construction risk allocation based solely on the capability to construct); Ability to monitor/control/plan and provide political support of the respective (public) contracting authority; Adoption of innovation and its successful application; Life cycle planning and operation (Life cycle planning verification; Capability to operate; Operation risk allocation as per contractual agreement; Assessment of optimal operational risk allocation based solely on the capability to operate).

*The **Revenue Support Indicator*** is a measure of the project's ability to generate revenues. It is a composite indicator that includes: The level of coopetition of the new (greenfield) and existing (brownfield) parts of the project; revenue from transport and non-transport sources managerial assessment.

*The **Reliability/Availability Indicator*** represents the level of physical and operational reliability and availability of the infrastructure and the transport service.

*The **Governance indicator*** refers to factors setting the governance scene within a project. In this respect, it is defined by the contractual conditions and the process leading to them. Moreover, the governance indicator reflects efficient/effective contractual governance accompanied by flexibility /control. In this context "*good* governance" describes a contractual arrangement that is effective/efficient and also exercises flexibility and control.

*The **Remuneration Attractiveness Indicator*** represents the various income sources with their assessed risk and potential cost coverage.

*The **Revenue Robustness Indicator*** represents the various revenue sources with their assessed risk and potential cost coverage.

*The **Financing Scheme Indicator*** reflects an expanded version of the weighted average cost of capital included in the project from both public and private sources (1-$WACC_{ad}$).

Snapshots: Are time-specific sets of typology indicator values describing a project case at various points in its life cycle.

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Executive Summary

"Transport infrastructure has been traditionally considered as a precondition for economic development at various geographical levels (local, regional, national, European). At the same time the reduced capability of public budgets to fund directly transport infrastructure has led in recent years to the adoption of funding schemes involving private funds and contractual models known as public-private partnerships (PPP). These schemes have been in operation across Europe for several years already, in different arrangements and with varying degrees of success in each case.

This action provides a comprehensive analysis of alternative funding schemes (public, PPP or other) based on the existing experiences in different transport sectors and geographical areas, and assess their impact with regard to economic development, value for public money, user benefits, life-cycle investment (including maintenance), efficiency, governance and procurement modalities, etc."[1]

The BENEFIT project looks at infrastructure project delivery performance. Amongst various infrastructure project outcomes, it focuses on four which are at the heart of the analysis of all major project stakeholders and which influence either directly or indirectly all other anticipated outcomes when a specific project is considered for financing (public or other): cost and time to (construction) completion and actual versus forecast traffic and revenues.

In its research approach, the BENEFIT project does not look into assumptions and considerations that have taken place or may have been relevant prior to project award. In effect, it does not re-assess or examine the reasons of selecting a particular financing scheme and/or project delivery model (PPP or traditional public procurement). It further assumes that projects have a clear "raison d'être" and that the decision to move forward with their implementation has been a rational one.

The BENEFIT project investigates and researches the conditions and factors leading to the achievement of the above four outcomes distinctively from one another and remains stakeholder neutral as it does not assume the perspective of any project participant. **Consequently, it does not try to measure project success or failure but simply provides assessments as per the likelihood to attain each of the aforementioned target outcomes. The overall project assessment is left to the individual stakeholder to assess based on their own value system, interests and preferences.**

Furthermore, the BENEFIT project has not differentiated its research methods depending on their financing and/or procurement scheme of the projects considered. Projects procured/financed by the public sector itself or through Public Private Partnership schemes are treated with the same analytical tools and within the same analysis framework. Within BENEFIT Public Private Partnerships are defined as projects that have been delivered by employing private financing (at various levels/combinations), bundled (at least) in terms of the construction and operation phases, and in which, due to these provisions, project risks may have been allocated/transferred to the private sector.

Within the course of the BENEFIT project, a sample of 86 project cases covering all modes of transport and 24 European countries was analysed (see section 2.2 and Annex 4). Information from these projects was captured at various points in their life cycle; considered from their award until well into their operation. The limitations of the sample were addressed by following a multi-analysis approach (see section 3.1).

This **multi-analysis approach along with the fundamental BENEFIT concept**, which represents transport infrastructure delivery and operation through sets of indicators that can quantitatively capture facets of performance over the life cycle of the project, constitute the **innovation of the BENEFIT project** and its comparative advantage to previous research efforts of infrastructure project assessment.

The findings of the analyses undertaken are summarised concisely per analysis approach in Annex 1 of the present report and showcase the richness of results that may be achieved by employing a combination of different methodologies. The synthesis and comparison of findings lead to a deeper understanding of

[1] Text from call MG 9.3 -2014 to which this call is a response to.

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factors influencing project performance and form the basis of lessons learnt. These are presented in Chapter 3 of the present report.

A key conclusion of the BENEFIT study is that transport infrastructure project performance is rather **independent of the financing scheme**, as **the conditions of improved performance are mostly related to the actual project characteristics and the competences of the involved parties**, including in all cases the competence of public contracting authority and the level of **sharing of responsibility** (risks) amongst the involved parties based on their **ability to manage** them.

While, the implementation context (macro-economic conditions, country competitiveness, supporting institutions) is beyond the control of project decision-makers (exogenous to the project) and may significantly influence project performance, there are also **actionable factors** (endogenous to the project) that may be influenced by them.

Actionable factors of project implementation may be categorised as structural and policy. Structural factors pertain to project internal characteristics that are mostly defined during the planning, tendering and award stage (project maturity, business model and contractual conditions/configuration). Their improvement enhances the potential of achieving project targets. Policy factors are actionable throughout the project life-cycle and induce trade-offs with respect to the achievement of project outcomes. They are related to internal project characteristics that affect funding and financing arrangements (financing structure, project income (remuneration scheme) and project revenue streams) which may be set initially at the front end of the projects (planning, procurement and award phases) but may subsequently be modified in order to support the attainment of particular project outcomes. Notably, **by adjusting** the aforementioned factors (**financing, remuneration and revenue scheme**) **project decision makers may favour one outcome over another, and, in this context, express a particular project policy and strategic**.

Each transport infrastructure mode is influenced differently by its implementation context and different combination of factors contribute in each case to achieving the respective target outcomes. The difference lies primarily in the ability to fully endorse factors identified to support the achievement of project outcomes.

In addition, it was found that:

- There is **no single factor** that can define on its own the likelihood of achieving an outcome target but rather **combinations of them**;
- There is **no single combination of factors** that can secure the successful attainment of all project outcome targets simultaneously;
- **Outcome targets are not achieved by the same combination of factors across all modes** of transport.

While the above lessons may have been reported through other past and concurrent research, the BENEFIT project goes a step further: BENEFIT delivers a **Transport Infrastructure Resilience Indicator (TIRI) with a corresponding rating system and methodology** (see Chapter 4).

In the context of BENEFIT, resilience is defined as *"the ability of a transport infrastructure project to withstand, adjust and recover from changes within its structural and implementation elements with respect to its ability to deliver specific outcomes (such as cost and time to completion, expected traffic and expected revenue targets)".*

Exploiting the power of its indicators and the synthesis of findings, the BENEFIT project delivers a rating system describing the likelihood of a project at a certain point in its life cycle to deliver on expected targets (cost and time to (construction) completion and actual versus forecast traffic and revenues). The TIRI, which is given in a static and a dynamic form, allows project decision-makers and those involved in project delivery to:

- Identify project vulnerabilities both with respect to its external implementation environment as well as its internal structural characteristics
- Improve the likelihood of a project to reach specific outcome targets

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- Monitor project "health" during construction and operation
- Adjust project factors according to expectations.

Notably, while there are influencing factors exogenous to the project which cannot be adjusted, there are also actionable factors to be considered. Again, the ability to take action on a number of factors gradually reduces from the project's planning phase onwards. However, BENEFIT has identified three indicators related to the remuneration scheme, the revenue scheme and the financing scheme that induce trade-offs between cost and time to completion and also between traffic and revenue outcomes. The rating methodology may guide project decision-makers as to how to balance between these indicators in order to achieve the preferred trade-off. Notably, the TIRI rating may also indicate when actions are not likely to bring about the desired outcome leading to considerable savings in efforts and resources.

This present report ends with recommendations (see Chapter 5). Emphasis is placed on:

- Furthering the development of strong institutions in support of competitiveness on a national and European level
- Project Structure, considering:
    - The promotion of viable and mature projects (robust and evidence-based raison d'être of the project; with well-developed demand forecasts which consider a wider range of potential growth scenarios; life cycle planning)
    - Enhanced business models based on network connectivity, integration in local/regional/national development, and combination with other services (integrated (bundled) projects)
    - Competences and Capabilities (Strengthening the competences of the public contracting authority; ensuring the participation of competent contractors who are able to manage and bear the technical risks of a specific project; and considering suitable operators by assessing their ability to manage, control and influence demand; should all be key considerations when designing the procurement process and preparing the tender documents for the delivery of transport infrastructure projects delivery)

- Governance: Contracts should include terms and conditions which support the "efficiency/effectiveness of governance" and "contractual flexibility/control". Long term contracts are inherently incomplete and renegotiations are almost inevitable in an ever-changing economic, technological and social environment. The introduction of shorter contractual periods should be investigated.

- Funding Scheme: It is important to differentiate between remuneration methods and revenue schemes. This would allow for proper and fair user charges in accordance with willingness to pay and the implementation of public tariff and mobility policies. Remuneration schemes also reinforce potential incentives and trade-offs (see previous sections).

- Financing Scheme: While **evidence was not found on differing performance between traditional and PPP procurement,** it was found that the financing scheme structure in combination with the remuneration and revenue scheme creates incentives and induces trade-offs between cost and time to completion, as well as the attainment of traffic and revenue targets. The impact of these trade-offs on transport infrastructure project goals (relief of congestion, reduction of travel time, environmental impact etc.) should be carefully considered, as project benefits and welfare gains might be reduced or lost. In addition, given the fact that PPPs are costlier than public projects in terms of the employed capital, it is important to understand whether this additional procurement cost is justified in terms of the accrued benefits. This has direct implications for the assessment of Value for Money as respective methodologies should be reviewed and revised to take into account the financial contributions required by the public sector in PPP projects which are often neglected or underestimated.

- Research on new financing schemes is needed. Financing Schemes based solely on protecting against risk, lead to a higher cost of capital and greater contributions by the public sector to render

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projects financially viable. As the key consideration in financing is risk, the search for new financing schemes lies in identifying means by which project risk may be minimised. According to the BENEFIT project findings, the focus should be on:

- Project internal characteristics and management.
- Developing and/or including in a project's structure a mix of competences able to appropriately internalise risk as opposed to relying solely on measures of risk mitigation which may lead to greater risk premiums.
- New actors, especially those possessing competences in innovation, should be encouraged to enter the transport infrastructure delivery and operation market. Their contribution is anticipated to improve the mix of competences involved in project delivery and operation.

Finally, the cost of capital and, consequently, the cost of the financing scheme has been heavily dependent on the national implementation context. The **BENEFIT** project has put forward a decision guiding tool (the Transport Infrastructure Resilience Indicator and its rating system), which would allow for an **improved assessment of a project's potential** to reach specific outcomes and, also, of the impact of built-in managerial flexibility over the life-time of the project under specific implementation conditions. Hence, **as uncertainty is reduced so should the cost of capital and the overall cost of the financing scheme.**

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Abbreviations

MF	:	Matching Framework
TIRI	:	Transport Infrastructure Resilience Indicator
S-TIRI	:	Static Transport Infrastructure Resilience Indicator
D-TIRI	:	Dynamic Transport Infrastructure Resilience Indicator
O-TIRI	:	Overall Transport Infrastructure Resilience Indicator
FEI	:	Financial – Economic Indicator
InI	:	Institutional Indicator
GI	:	Governance Indicator
CSI	:	Cost Saving Indicator
RSI	:	Revenue Support Indicator
RAI	:	Remuneration Attractiveness Indicator
RRI	:	Revenue Robustness Indicator
MEAI	:	Market Efficiency & Acceptability Indicator
FSI	:	Financing Scheme Indicator
IRA	:	Reliability-Availability Indicator
fsQCA	:	Fuzzy-Set Qualitative Comparative Analysis
IA	:	Importance Analysis
CRA	:	Credit Rating Agencies
PPP(s)	:	Public Private Partnership(s)

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1 Introduction

1.1 Introduction to the BENEFIT Project

BENEFIT seeks to take an innovative approach by analysing funding schemes within an inter-related system. Funding schemes are deemed to be “successful” (or not) depending on the Business Model that generates them as well as their stakeholders and policy contexts. The performance of the Business Model is affected by the implementation typology and the transport mode context – together with other contextual changes over time and space, including changes in overarching policy frameworks. It is matched successfully (or not) by a financing scheme. Relations between actors are partially described by a governance model (contracting arrangements). These are key elements in Transport Infrastructure Provision, Operation and Maintenance, as illustrated by Figure 1.1.1.

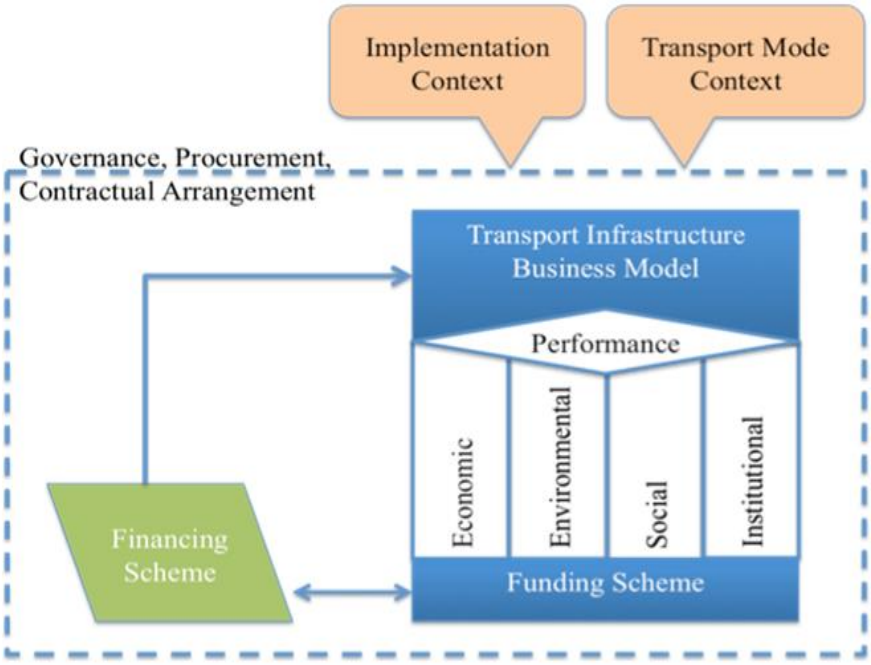

Figure 1.1.1 BENEFIT Key Elements in Transport Infrastructure Production, Operation and Maintenance

Success in relation to the application of a particular business model is seen here as an assessment of the appropriate matching of elements. Within BENEFIT funding and financing schemes are analysed in this respect. Describing these key elements proposed through their characteristics and attributes and clustering each of them into typologies is the basis of, first, developing a generic input/output model. Identifying best matches and their inter-relations (matching principles) leads to move from a generic model to a Decision Matching Framework that is developed to provide policy makers and providers of funding (and financing) extensive comparative information on the advantages and limitations of different funding schemes for transport infrastructure projects and improve the awareness of policy makers on the needs of projects serving an efficient and performing transport network within the Horizon 2050. Moreover, the model allows policy makers to identify changes that may be undertaken in order to improve the potential of success, such as improving the value proposition of the business model.

In developing this model, BENEFIT takes stock of project profiles known to its partners in combination with a meta-analysis of relevant EC funded research and other studies carried out with respect to funding schemes for transport (and other) infrastructure and direct contact with key stakeholder groups.

More specifically, BENEFIT uses the published project profile descriptions of **seventy-five** transport infrastructure projects funded and financed by public and private resources from nineteen European and

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four non–European countries covering all modes of transport. It also exploits twenty-four European country profiles with respect to contextual issues (institutions, regulations, macroeconomic and other settings) influencing funding and financing of transport infrastructure. This data has been produced within the framework of activities undertaken by the OMEGA Centre for Mega Projects in Transport and Development and the COST Action TU1001 on Public Private Partnerships in Transport: Trends and Theory. In addition, BENEFIT, through its partnership and respective experts, consolidates almost twenty years of successful European Commission research with respect to issues related to transport infrastructure and planning, assessment and pricing of transport services. In this sense, the approach is supported by the tacit knowledge and insights of the BENEFIT partnership with respect to infrastructure projects in transport.

By applying the Decision Matching Framework, BENEFIT undertakes:

- An ex-post analysis and assessment of alternative funding schemes (such as public, PPP & PFI amongst others) based on existing experiences in different transport sectors and geographical areas and their assessment with respect to economic development, value for public money, user benefits, life-cycle investment, efficiency, governance and procurement modalities, etc.; and, provides lessons learned, identification of the limitations of the various schemes and the impact of the economic and financial crisis.
- An ex-ante (forward) analysis and assessment of the potential of transport investments and the related funding schemes, including innovative procurement schemes still in a pilot phase, to contribute to economic recovery, growth and employment, in view of future infrastructure needs with a 2050 horizon for modern infrastructure, smart pricing and funding.

BENEFIT is concluded within twenty one[2] months and bears the following stakeholder focus and policy scenarios:

- Transport infrastructure business models and their project rating: Improved value propositions lead to funding schemes with enhanced creditworthiness enabling viable financing, balancing of project financing and funding risks, increasing the value basis of stakeholders and highlighting the potential of transport investments.
- Transferability of findings with respect to lessons learned, limitations and the impact of the economic and financial crisis through the introduction of typologies for particular sets of stakeholders under different scenarios.
- Open-access case study database in a wiki format, allowing for continuous updates and providing a knowledge base serving both practitioners and researchers.

[2]Twenty two months following the last BENEFIT project grant agreement amendment.

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1.2 Contribution of this report to the BENEFIT Project

The work undertaken under Task 5.3 aims to deliver against the following objectives, as stated in the BENEFIT proposal:

"Taking stock of all BENEFIT deliverables, task 5.3 consolidates Policy Guidelines and Recommendations. It includes an overall operational description of the Decision Matching Framework along with illustrative examples of applications (task 5.1). It will also include the crystallized input from the consultation group and the Policy Dialogues. It will be structured as an easy to use guide form. Partners with predominant transport policy expertise are designed to contribute."

The present report constitutes the **Final Deliverable of the BENEFIT Project**, which, on the one hand consolidates the collective work and analysis carried out throughout the entire project, while on the other, is forward-looking in terms of capitalising on results to set forth policy guidelines and recommendations for policy makers and practitioners in view of current and future transport infrastructure investment needs. Accordingly, the main aims of the present document are to:

- Consolidate, summarise and report all BENEFIT's key findings and lessons learnt.
- Present the finalised BENEFIT Matching Framework Policy Guiding Tool.
- Propose relevant policy guidelines and recommendations.

1.3 Report Structure

Following this introductory Chapter 1, the report is structured as follows:

Chapter 2 offers a brief background to the project and the research conducted. More specifically, it describes the objectives of the project and its expected impacts, the database upon which all study and research has been based, and the BENEFIT Matching Framework concept as it has been formulated and crystallised during the course of the project.

Chapter 3 puts forward key findings and lessons learnt with respect to transport infrastructure project delivery and implementation. A multi-level, multi-analysis approach has been adopted in the course of the BENEFIT project. The findings of the multiple analysis streams carried out are listed per type of analysis in Annex 1 of this report.

Chapter 4 is dedicated to the BENEFIT Matching Framework Policy Guiding Tool. The Chapter focuses on the proposed Transport Infrastructure Resilience Indicator, its corresponding rating system, its domain of applications, as well as recommendations for further development.

Chapter 5 concludes the report with policy guidelines and recommendations as these are derived from the entire study and research conducted within the BENEFIT project.

The report is supported by a number of Annexes.

Annex 1 presents a summary of findings from the BENEFIT project as produced through each analysis undertaken.

Annex 2 is a summary report of the synthesis of findings with respect to how each indicator impacts each of the project outcomes considered (cost and time to completion, actual versus forecast traffic and revenues) per mode.

Annex 3 presents the Transport Infrastructure Resilience Indicator Rating System per outcome and infrastructure mode.

Finally, Annex 4 lists the project cases collected and analysed within the BENEFIT project.

2 Background to the BENEFIT Project

The present Chapter provides a brief background to the BENEFIT project. This includes:

- The project objectives and expected impacts as defined in its original scope.
- The brief description of the project cases upon which all research and analysis have been based, and finally,
- A concise presentation of the key characteristics of the BENEFIT Matching Framework as it was developed during the course of the BENEFIT project.

2.1 BENEFIT Project Objectives and Expected Impacts[3]

The BENEFIT project put forward a Conceptual Framework of transport infrastructure delivery and operation (see figure 1.1.1), which constitutes the basis for the BENEFIT Matching Framework. By conducting **ex-post analysis and assessment** of *actual experience*[4], relevant findings are used to develop a **policy guiding tool** and a **project rating framework**[5]**.** The policy guiding tool aims to be used to conduct **ex-ante analysis** of the *potential of transport investments and the related funding schemes*[6].

The ex-post analysis and assessment included:

- *Lessons Learnt* analysis of "mismatches" of funding and financing schemes and the identification of the underlying source/cause (implementation context, transport mode context, governance, procurement and contract arrangement, business model value propositions and performance). *Lessons learned* were approached from three different angles[7]: (i) A descriptive statistics analysis with respect to project performance[8], (ii) a qualitative analysis of the funding and financing schemes of projects from various parts of Europe and transport modes with respect to performance[9] and (iii) an analysis vis-à-vis the BENEFIT Matching Framework to validate and demonstrate its modelling approach[10].
- *Limitations of PPP and other funding schemes* addressed by mapping of interrelations of influential factors[11].
- *Analysis of the effects of the recent economic and financial crisis*[12]*.*

BENEFIT aims to serve the EU Transport Policy. Its expected impacts, as defined in the original project description, contribute to:

- Effective and efficient transport Infrastructure project planning and implementation capacities
- The inclusion of wider value propositions for the transport infrastructure business model and synergies across sectors
- Advantageous exploitation of funding and financing schemes
- Support of innovation in transport infrastructure delivery and operation
- The enhancement of transport infrastructure project creditworthiness

[3] Summary from Annex 1
[4] Scope in the topic MG 9.3 (items 1, 2 and 3)
[5] See BENEFIT Deliverable D3.2
[6] See BENEFIT Deliverable D5.1
[7] Only two in the initial project description and Annex 1
[8] See BENEFIT Deliverable D4.1
[9] See BENEFIT Deliverable D4.2
[10] See BENEFIT Deliverable D4.2
[11] See BENEFIT Deliverable D4.3
[12] See BENEFIT Deliverable D4.4

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2.2 BENEFIT Project Case Database

The BENEFIT project case database constituted the basis of all analyses undertaken. It includes 86 cases comprising 55 PPPs and 31 public projects. Project-related information was systematically collected following the BENEFIT project case data collection protocol[13]. Figures 2.3.1 and 2.3.2 present their distribution with respect to transport mode and country of implementation, respectively. Both delivery models are clearly differentiated through colour coding.

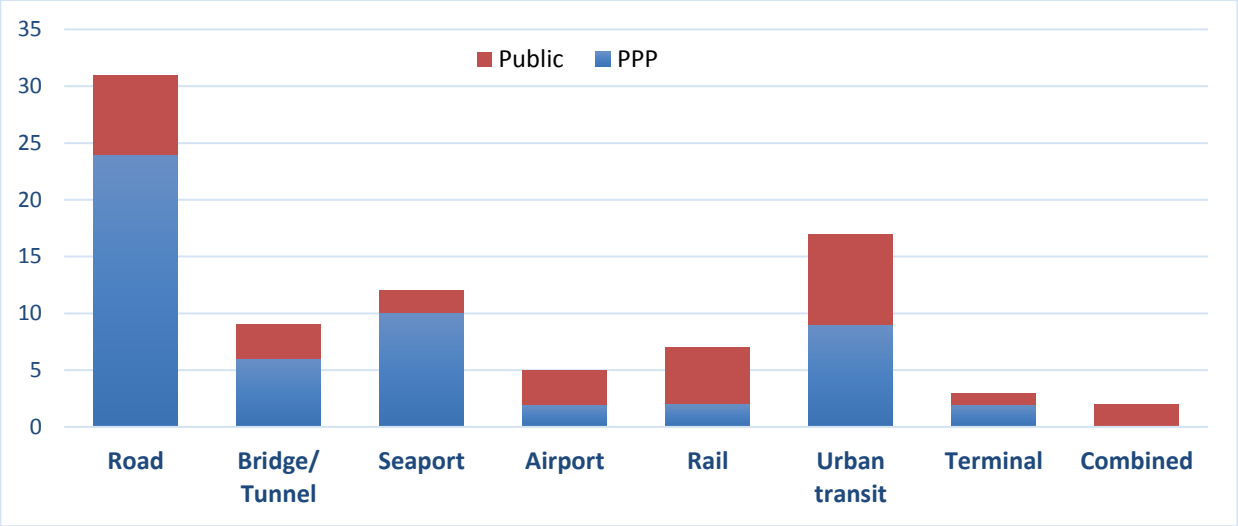
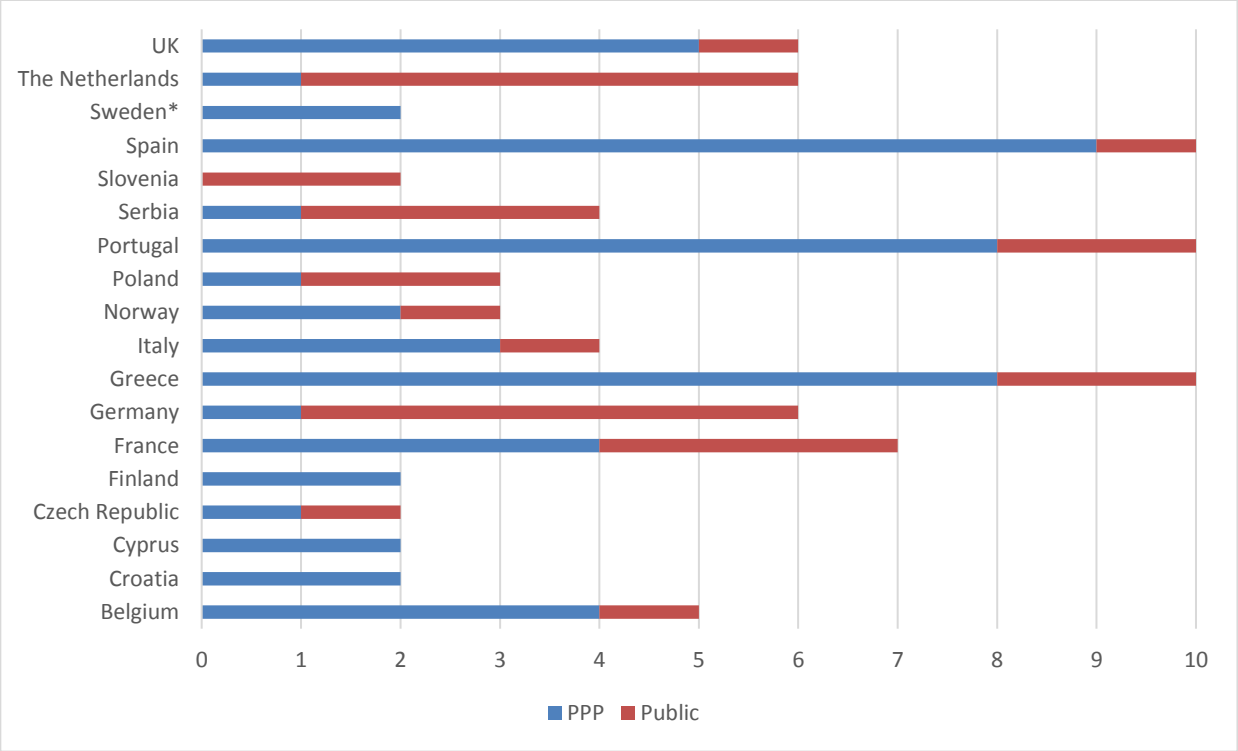


Figure 2.3.1.: Distribution of BENEFIT Case studies per principle mode



**One Project Shared with Denmark*

Figure 2.3.2: Distribution of BENEFIT Project Case per country

[13] See BENEFIT Deliverable D2.1

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However, the data that was needed to model these project cases based on the BENEFIT Matching Framework configuration was not always available. As a result, only 56 cases were employed in the various analysis streams that depended on the Matching Framework[14]. The distribution of these project cases per country and mode is illustrated in figures 2.2.3 and 2.2.4 respectively.

It is important to mention that project cases described in the BENEFIT Matching Framework format have multiple values of their respective sets of indicators which correspond to different times of their delivery life-cycle (termed “snapshots” in the BENEFIT project). On average 3.5 snapshots were generated per project which enabled the use of quantitative analysis methods.

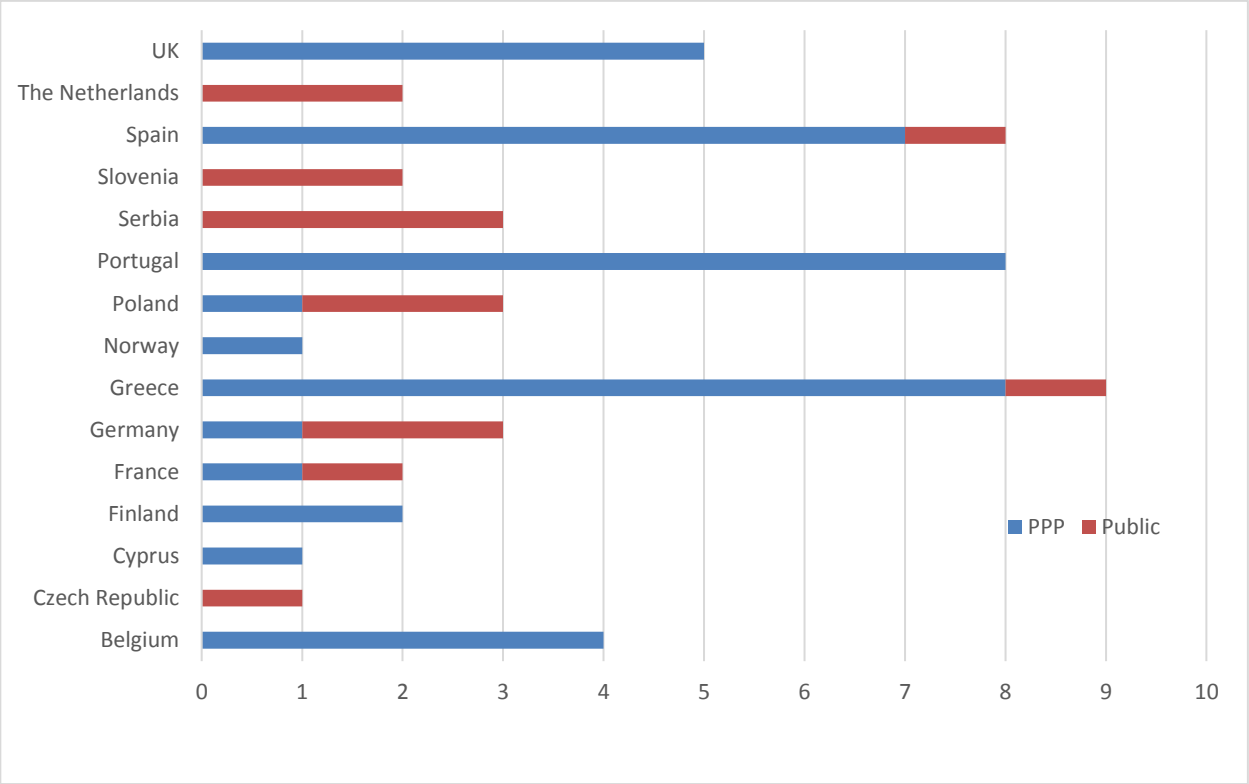

Figure 2.3.3.: Distribution of Cases in Indicator Format per Country

[14] See Annex 1 of the present report for the number of project cases employed in each analysis.

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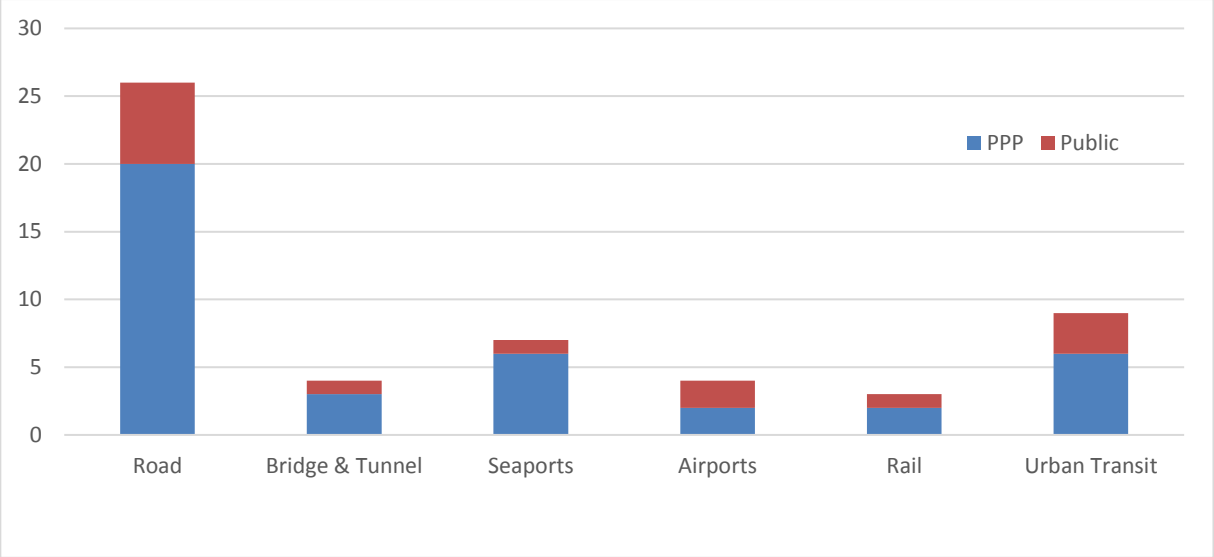

Figure 2.3.4.: Distribution of Project Cases in Indicator Format per Mode

The sample selection process was based in principle on accessibility of information and leveraged project information captured in the COST Action TU1001 and OMEGA Centre project databases. Notably, all information collected for the BENEFIT project case database is in the public domain.

Road projects compose the greater part of the sample for both descriptive/qualitative analysis and Matching Framework analysis. This fact was taken into account when considering findings generated from the entire sample. Moreover, the project followed a multi-analysis approach. Findings were synthesised placing particular importance on the results of the qualitative analysis per mode, which was used to guide the interpretation of quantitative findings[15]. Equally useful in this multi-analysis approach was the employment of fuzzy set Qualitative Comparative analysis, which holds the middle ground between qualitative and quantitative analysis.

As can be seen from the above figures, some countries are over-represented in the sample. This was also taken into account in both qualitative and quantitative analyses.

Furthermore, the small number of project cases in some mode categories limited the potential for a full analysis of the respective infrastructure modes.

Finally, while significant effort was placed on including projects financed purely by the public sector, this proved extremely difficult as the relevant information was not readily available. This limitation was intensified by the fact that the construction of publicly financed projects involves multiple contracts which were hard to trace.

In this context, the OMEGA Centre project database, initially endorsed for its expected contribution of publicly financed projects, could only be used for qualitative analysis as no additional information, which was necessary for quantitative analysis, could be collected on its projects.

The full list of project cases employed in the BENEFIT project, their origin/provider and their respective exploitation in the various analyses is presented in Annex 4 of the present report.

[15] See for example BENEFIT Deliverable D3.2

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2.3 The BENEFIT Matching Framework

The key BENEFIT working concept views transport infrastructure project implementation as a system of key elements (see figure 1.1.1). The key elements considered are: the implementation context; the business model; the funding scheme; the financing scheme; the contractual governance conditions of implementation; and, finally, the transport mode context. The focus herein is on the interaction of these elements expressed through appropriately selected indicators.

The transport infrastructure delivery system is dynamic in nature. More specifically, it changes over time in response to or as a result of changes in the external and internal project environment. These changes are reflected in the values of the various indicators. Within the BENEFIT project, the dynamic nature of a transport infrastructure project is represented through multiple sets of indicators (termed "snapshots") describing the project at specific times of its delivery life cycle[16].

The proposed model, as any system, receives inputs and generates outputs/outcomes. In the following sections system inputs and outputs are described and the elements of the model are presented in their final indicator configuration[17].

2.3.1 System Input and Outcomes

The procurement and delivery of transport infrastructure projects is the outcome of a decision making process that considers transport-related as well as wider policy goals. Based on such considerations, projects are selected for implementation with a view to attaining clearly set goals. The expected goals define project technical characteristics (e.g. type of infrastructure, scale, size, materials, etc.), which, in turn, determine the magnitude of the investment to be made. Finally, a decision is made about whether the project will be procured as a purely public project or will include private co-financing. The above decisions are considered as input to the BENEFIT system model and their detailed modelling lies outside the scope of the system. However, it is recognised that such decisions carry a significant weight in terms of the subsequent structuring of the project and could, therefore, be of critical importance to its overall success.

All initial decisions are assumed to be made in a rational way leading to projects that have a clear and rational "raison d'être". Notably, non-rational or sub-optimal decisions feature as system imbalances.

Furthermore, every transport infrastructure project produces outcomes that fall under five potential categories:

- Level of achievement of transport goals: pertaining to the degree by which the project has achieved its transport-related "raison d'être" (e.g. relieving congestion, increasing mobility, etc.);
- Level of achievement of forecast traffic: pertaining to the degree by which the project has met its initial usage expectations;
- Level of achievement of forecast revenues: pertaining to the degree by which the project has met its initial revenue expectations;
- Level of achievement of project management targets: pertaining to the degree by which the project has been delivered within time, budget and specifications (i.e. "iron triangle" considerations);
- Level of achievement of other benefits (economic, environmental, societal, institutional): pertaining to the degree by which the project has managed to deliver originally anticipated benefits that cannot be "harvested" by the Business Case[18], such as economic returns to society, environmental benefits, institutional changes, etc. (as and where applicable).

The BENEFIT model is "operationalised" to address only four specific outcomes. Two pertain to Project Management outcomes: cost and time to (construction) completion. The other two correspond to

[16] See BENEFIT Deliverable D3.1

[17] See BENEFIT Deliverables D2.2; D2.3; D2.4; D3.1; D4.2 and D4.4.

[18] The Business Case is defined as the value of the project that is anticipated to be "captured" and its corresponding costs (investment). The Business Case forms the basis for all the corresponding contractual arrangements.

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infrastructure operational goals, which are also critical in order to justify the investment: actual vs. forecast traffic and actual vs. forecast revenues.

2.3.2 System Indicators

As previously mentioned, the key elements considered to describe the transport infrastructure and delivery system are: the implementation context; the business model; the funding scheme; the financing scheme; the contractual governance conditions of implementation; and, finally, the transport mode context. These elements are described by respective composite indicators, which have been developed, validated and revised[19] during the course of the BENEFIT project. These are briefly presented below[20].

Element: Implementation Context
Indicators: Financial-Economic (FEI) and Institutional (Inl)

The implementation context is described by two indicators: the **Financial-Economic (FEI)** and the **Institutional (Inl) indicators**. These indicators encompass more than their title may suggest and are built based on international indices published by prominent international institutions. More specifically, the Institutional indicator shows the extent to which the political, legal, regulatory, and administrative context in a country is stable and of a high quality. The Financial-Economic indicator measures more broadly the business environment and can be seen as a proxy of the level of productivity of a country as it focuses on the capacity of the national economy to achieve sustained economic growth over the medium term, controlling for the current level of economic development.

Element: Transport Mode Context
Indicators: Reliability/Availability Indicator (IRA)

Finally, the transport mode context is described with one indicator within the system: the **Reliability Availability Indicator (IRA)**. Notably, other characteristics relevant to this element constitute input to the system and cannot be changed during implementation (e.g. infrastructure type, size of investment).

The above indicators were constructed based on theoretical underpinnings[21]. They were validated using project case data[22] and revised based on the combined and multiple analyses of the indicators[23]. The individual analysis and validation of the proposed indicators also led to interesting findings and conclusions and, in turn, to the respective policy guidelines and recommendations. These are included in the relevant sections of this report.

Element: Business Model
Indicators: Cost Saving (CSI) and Revenue Support (RSI)

The Business Model element is described by two composite indicators representing the two major parts of the business model, i.e. costs and revenues. The corresponding indicators also aim to capture conditions improving efficiency and effectiveness which essentially lead to Cost Saving and Revenue Support.

In this context, the composite **Cost Saving Indicator (CSI)** illustrates a measure of a project's efficiency during construction and operation. In effect, it includes the ability to construct (level of civil works/ technical difficulty; capability to construct based on the market position of the contractor with respect to construction or respective project delivery capability (example for rolling stock); construction risk allocation as per contractual agreement; assessment of optimal construction risk allocation based solely on the capability to construct); ability to monitor/control/plan and provide political support of the respective public or contracting authority; adoption of innovation and its successful application; life cycle planning and operation (life cycle planning verification; capability to operate based on the market position of the operator; operation risk

[19] See BENEFIT Deliverables D2.2; D2.4; D2.3; D3.1; D4.2; D4.4
[20] See BENEFIT Deliverable D3.2 Chapter 6 for a detailed updated presentation of all indicators.
[21] See BENEFIT Deliverables D2.2; D2.3, D2.4
[22] See BENEFIT Deliverables D3.1 and D4.2
[23] See BENEFIT Deliverable D4.1

allocation as per contractual agreement; assessment of optimal operational risk allocation based solely on the capability to operate). .

The **Revenue Support Indicator (RSI)** is also a composite indicator that may be considered a measure of the project's ability to generate revenues, and also a measure of the project's efficiency in exploiting its potential sources of revenue. It includes the level of coopetition[24] of the new (greenfield) and existing (brownfield) parts of the project, expressing the level of business development scope designed to attract demand (e.g. airports etc.); the level of project exclusivity with respect to its position in the transport network (e.g. metros, bridge and tunnel projects, ports, airports under certain conditions); and the level to which a transport network supports the project's exclusivity. The RSI also includes revenue sources attached to the project (traffic from new and brownfield operation, traffic from other transport infrastructure bundled in the project, as well as revenues related to non-transport services, all in relation to the capability to manage demand; demand risk allocation; assessment of demand risk allocation based on the capability to manage demand; quality of service).

Element: Governance
Indicators: Governance Indicator (GI)

The Governance element is described by the composite **Governance Indicator (GI)**, which contains factors that reflect many aspects of the relationship between the contracting authority and the contractors. It refers to aspects of project governance such as early involvement of the contractor in the design and in the estimation of costs, procurement procedures, integration of design and construction, the incentives and disincentives regime, risk sharing, contract flexibility, and actions that enable the contracting authority to retain bargaining power during possible renegotiations.

Element: Funding Scheme
Indicators: Remuneration Attractiveness (RAI), Revenue Robustness (RRI) and Market Efficiency and Acceptability (MEAI) Indicators

The Funding Scheme element is described by two indicators: The **Remuneration Attractiveness Indicator (RAI)** and the **Revenue Robustness Indicator (RRI)**. The indicators consider the project income (from the perspective of the operator) and revenue streams (from the perspective of the project overall), respectively, weighted against the associated risks and are also cumulatively expressed in relation to the percentage of cost coverage they represent. An additional indicator proposed under the Funding Scheme typology has been the **Market Efficiency and Acceptability Indicator.** This indicator did not appear as significant in the current analysis and has been excluded from final results.

Element: Financing Scheme
Indicators: Financing Scheme Indicator (FSI)

The **Financing Scheme** element is expressed through one indicator, the **Financing Scheme Indicator** (FSI), which reflects an expanded version of the weighted average cost of capital of the project (WACC) that is able to consider financing contributions from both public and private sources.

[24] The term "coopetition" is used to denote the nature of competition between the various parts (projects) of the transport network, where both "cooperation" and "competition" exists.

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3 Lessons Learnt

3.1 Introduction

Addressing the BENEFIT Project objectives and expected impacts (see Chapter 2), the BENEFIT project followed a multi-analysis approach throughout its course. Starting from a purely descriptive statistics analysis[25], the workflow continued with parallel qualitative and quantitative analyses of the BENEFIT project case database based on the BENEFIT Matching Framework indicators[26].

More specifically, qualitative analysis was conducted per mode:

- On an Ad-hoc basis, to identify through case analysis the factors influencing project performance,
- Using the BENEFIT conceptual framework as an analysis framework
- Using the BENEFIT Matching Framework indicators as measures for the assessment of project performance.

The analysis of BENEFIT Matching Framework indicators was conducted by applying the following methodologies to the entire sample and appropriate sub-samples:

- Fuzzy Set Qualitative Comparative Analysis (fsQCA)
- Importance (or Sensitivity) Analysis (IA)
- Econometric Modelling.

In addition, ad hoc analyses were conducted to validate the construction of the BENEFIT Matching Framework indicators. These analyses also led to interesting findings and conclusions.

Furthermore, the limitations of the BENEFIT Matching Framework as well as the interrelations of its elements and constituent indicators were investigated through a cause and effect mapping study. This effort was based on specific project cases and aimed to enhance the understanding and the interpretations that originated from previous analysis streams.

Table 3.1.1 Analysis Conducted within the BENEFIT Project

Analysis / Sub-Samples	Descriptive Statistics	Qualitative Analysis (All Cases)			Limitations	Indicator Quantitative Analysis (Indicator Cases)		
	All Cases	Ad Hoc	BENEFIT MF	BENEFIT Indicators	Selected Cases	fsQCA	IA	Econometric Models
Full Sample	✓					✓	✓	✓
Projects Completed before the Crisis						✓	✓	✓
Projects Completed after the Crisis						✓	✓	✓
Road		✓	✓	✓		✓	✓	
Bridge & Tunnel		✓	✓	✓				
Urban Transit		✓	✓	✓				
Rail		✓	✓	✓				
Airports		✓	✓	✓				
Ports		✓	✓	✓		✓		
Non-Road						✓		

Table 3.1.1 presents the analyses that have been undertaken within the BENEFIT project. In all cases, the financing scheme (PPP vs public financing) was investigated and the focus was to identify factors influencing project outcomes and measuring the impact of the recent financial crisis. Some findings, produced through

[25] See BENEFIT Deliverable D4.1

[26] See BENEFIT Deliverables D4.2, D4.4 and D3.2

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the various analyses, were cross-cutting. Some findings were generated through the combination and complementarity of all analyses.

Findings were discussed in two **Policy Dialogue** events, which took place in Milano, Italy and Frankfurt, Germany. Policy Dialogue events also produced their own findings[27].

All BENEFIT project findings as generated through the various analyses and their synthesis thereof[28] are summarised per analysis approach in **Annex 1** of this report.

In each analysis, the focus was placed on factors and conditions supporting key project outcomes. As mentioned earlier, of the large range of possible project outcomes, only four were assessed when considering the funding and financing of transport infrastructure project delivery and operation:

- Cost to (construction) Completion
- Time to (construction) Completion
- Actual versus Forecast Traffic
- Actual versus Forecast Revenues.

While the above outcomes do not capture the entire scope of a project, they are directly related to the structuring of its funding and financing.

BENEFIT recognises the importance and potential positive impacts a project may have on the wider economy, society, and environment. As these wider positive impacts may counterbalance less-than-expected performance on any of the above-mentioned outcomes, **BENEFIT knowledgeably does not attempt to provide an overall assessment of a project**. The scope of findings and lessons learnt presented concerned the potential to solely achieve the above stated outcomes, independently of the alignment or disparity of perspectives and objectives that relevant actors may have. In this context, **BENEFIT is stakeholder–neutral**. It remains to the individual stakeholder to weight and assess the relative importance of achieving specific or a combination of outcomes, keeping in mind that these may be related with other outcomes which are not considered in the present study.

The research effort has been conducted on four levels:

1. Identifying key factors that influence transport infrastructure project performance, especially with respect to the implemented funding and financing scheme.
2. Expressing transport infrastructure project performance through a system of indicators (BENEFIT Matching Framework), which capture the key factors and their interrelations as these affect the expected outcomes.
3. Identifying factors influencing the performance of each mode.
4. Assessing and improving the explanatory power of the BENEFIT Matching Framework.

Lessons Learnt, which are presented hereafter, are structured along the first three aforementioned levels. The assessment of the explanatory power of the BENEFIT Matching Framework is included in the next Chapter, along with the full description of the BENEFIT Policy Guiding Tool.

[27] See BENEFIT Deliverable D5.2

[28] Also see BENEFIT Deliverable D3.2

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3.2 Cross-Cutting Lessons Learnt

BENEFIT has arrived to a number of **overarching lessons learnt which transcend differences in mode characteristics**. These cross-cutting lessons are structured along the elements of the BENEFIT Matching Framework (See figure 1.1.1). The section ends by highlighting lessons with respect to the impact of the global crisis, which represents the adverse effects of a poor implementation context.

3.2.1 Implementation Context

With respect to the four basic performance outcomes studied, no single combination of factors was identified having a positive effect on all four targets. For each performance target, at least partially, different factors seem to matter. However, one factor that was identified to have an impact on all outcomes was the implementation context studied in terms of financial-economic context and institutional context. Notably, while the effect of financial-economic context is well acknowledged with respect to traffic and revenue, this study has now concluded that a poor financial-economic context or declining conditions also have a **negative effect on construction cost and time to completion**. The effect was found to be **greater on time to completion**.

Furthermore, it was observed that under certain conditions[29], **strong institutions may limit or cancel** the effect of a poor or declining financial-economic environment. In this context, **projects implemented in countries with strong institutions bear potential to withstand and recover from financial shocks.**

Finally, while the implementation context has been under significant scrutiny in the years following the global economic crisis, significant changes (both drops, but also increases) have been witnessed over the last 20 years in all European countries. The importance of understanding how to withstand and recover, and also, exploit such fluctuations is significant.

3.2.2 Transport Mode Context

As noted earlier, it was found that each mode bears specific characteristics of delivery and operation. The importance of these characteristics in achieving project outcomes is presented later in this chapter. However, key to achieving targets is the **availability and reliability** of the infrastructure/transport service.

3.2.3 Business Model

The Business Model is described by a number of interrelated factors and conditions:

- The characteristics of the “value proposition”, i.e. the transport infrastructure project
- The parties and their competences directly involved in the delivery and operation of the project
- The responsibilities (risk allocation) and how these are shared between the relevant parties.

Transport Infrastructure Project Characteristics

The various analyses revealed a number of findings with respect to transport infrastructure characteristics. Some were seemingly contradictory. Lessons herewith try to go beyond initial observations seeking deeper cause and effect conditions, whilst building on observations and findings.

- Infrastructure projects considered **exclusive** have a natural control over traffic due to their **“position” in the network**. The present study identified the **importance of the intermodal network in supporting exclusivity[30] (“level of control/Coopetition[31]”).**

  Projects demonstrating a high level of control/coopetition were found to **perform better** with respect to all target outcomes and especially with respect to achieving traffic forecast even in adverse implementation conditions. However, the characteristic may be related to **proper project justification** as projects demonstrating a high “level of control” are also projects “needed” in the transport network.

[29] See Annex 2 of this report.

[30] The combination was termed “level of control or coopetition” in the BENEFIT project.

[31] The term “coopetition” is used to denote the nature of competition between the various parts (projects) of the transport network, where both “cooperation” and “competition” exists.

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In addition, projects with a high level of control/coopetition, combined services and/or multiple revenue streams are **less vulnerable to changes of the macro-economic environment** even when employing **demand-based remuneration schemes**.

Notably, the emphasis of "exclusivity" has been more pronounced with respect to achieving demand (and/or revenue targets). In many, PPP projects, the exclusivity of the project has been **contractually induced by incorporating contractual terms that protect against competition**. However, when network connectivity is not favouring, the competitive advantage is reduced.

- **Brownfield projects** or projects including a brownfield (connected) section may have greater potential of reaching pre-specified targets, as acquired knowledge of design and construction conditions, demand and other project maturity characteristics may be exploited. By the same token, these projects may also fail considerably if assumptions made based on the brownfield performance are not tested and thoroughly investigated. Therefore, when brownfield projects are involved, there is also a tendency to fast-track project preparation, which may prove disadvantageous.[32]

- **Project complexity** may be a source of risk in achieving project targets. However, the issue does not lie in the complexity per se but in the level of project development/detailing prior to implementation. For example, bridges and tunnels are technically demanding structures, which were not found to underperform with respect to cost and time to completion. In conclusion, when complexity is acknowledged and addressed in a proper way it is not a limiting factor.[33]

  Projects with combined services and, therefore, **multiple potential revenue streams** might also be considered complex. These projects showed cost overruns. Notably, while combining services is important in order to achieve economies of scale and integrated development, it also places stress on project maturity and requires enhanced management capabilities by the contracting authority. However, the incentive with respect to revenues seems to drive time to completion, where these projects perform better. As expected, integrated and combined service designed projects performed well with respect to demand and revenue targets.[34]

- **Investment size** is perceived to increase the risk of achieving project targets especially those connected to cost and time to completion. At the same time, investment size is also related to the size of the infrastructure project and the potential change that it may bring about in mobility patterns and the economy (Policy Dialogue Finding). However, in the overall sample no such correlation was identified. Medium investment size road projects and lower investment size urban transit projects were identified as more prone to cost overruns. Notably, this may be the investment size in the respective modes that is less studied ("scope creep" was in both cases identified as the prominent reason). It is concluded, that investment size cannot be considered a factor per se but deeper causes need to be addressed[35,36].

Competences and Capabilities

Competences and capabilities refer to the key stakeholders involved in the delivery of transport infrastructure projects.

- The **competence of the public contracting authority** was identified to be important in achieving cost and time to completion as well as traffic targets. Lesser competence was identified as the cause behind poor performance in urban transit projects, and locally driven bridge & tunnel projects. This

[32] See Annex 1 of this report and respective BENEFIT Deliverables: A.1.1; A.1.2.2; A.1.2.4; A.1.3; A.1.4.
[33] See Annex 1 of this report and respective BENEFIT Deliverables: A.1.1; A.1.2.2; A.1.2.4; A.1.3; A.1.4; A.1.5; A.1.9; also indicator analyses (fsQCA, IA, econometric models - – A.1.10; A.1.11; A.1.12) as project complexity is included in the CSI indicator
[34] See Annex 1 of this report and respective BENEFIT Deliverables: A.1.2.2; A.1.2.4; A.1.4; A.1.6; A.1.9; also indicator analyses (fsQCA, IA, econometric models – A.1.10; A.1.11; A.1.12) as multiple streams of revenues are included in the RSI indicator
[35] Investment size is also discussed under the heading of Competences and Capabilities. See Annex 1 of this report and respective BENEFIT Deliverables: A.1.1; A.1.2.2; A.1.2.4; A.1.3; A.1.4; A.1.5; A.1.6; A.1.7; A.1.8; A.1.13.
[36] Investment size is also discussed under the heading of Competences and Capabilities.

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factor, in combination with others, was also identified as a constituent part of the Cost Saving Indicator (see fsQCA, Importance Analysis and Econometrics Analysis). Within the context of the indicator the competence of the public contracting authority is related to capability to plan and develop projects, monitor contracts and manage stakeholders providing support to the project. Notably, a competent public contracting authority is capable of:

- Providing the "right" political support.
- Preparing mature projects. Notably, local and regional contracting authorities may lack respective competences and this may also be related to the lesser performance of small and medium sized investment projects.
- Managing the tender process
- Monitoring contract implementation

The competence of public contracting authority is also important for the implementation of **projects with bundled services** as there are greater management demands due to the complexity of both developing these projects to maturity and managing a greater number of stakeholders.

Optimism bias identified in a number of cases could also be traced back to the competence of the contracting authority. Public projects seem to be more prone to overestimated traffic forecasts but also PPP projects, especially when there is misappropriate demand/revenue risk allocation[37].

- The **competence of the contractor**, from all aspects, e.g. financial, technical and managerial, was identified as important. Cost and time overruns have been related to the level of competence demonstrated. Also, project **investment size,** through the tendering process**,** is usually connected to the financial and technical capability of the contractor. Smaller investment size projects are usually assigned to local or smaller construction companies, who may have limited resources (see bankruptcy examples in road projects). Larger investment size projects are, in principle, assigned to larger construction contractors, who operate in the international market and, while having the expertise, may be affected by global crises (see examples in bridge and tunnel projects).

- The **competence of the operator** was identified as an important contributing factor in achieving traffic targets. It was found to be an important characteristic for **projects with combined services** or **multiple streams of revenues**. This competence also extends to the ability to **manage the supply chain**. This characteristic was identified as important in the development of ports and airports. However**, strategic behaviour** was also suggested to be highly influential in these projects.

- **Innovation** challenges project maturity and also the competences of the involved parties. While innovation may be introduced to facilitate construction and improve efficiency of operation and maintenance, it may only have a positive contribution if respective experience exists. Findings from the bridge & tunnel sample as well as the road sample point to the positive impacts. Findings from Urban transit and rail suggest otherwise. Notably, it is a combination of **innovation maturity and contractor competence**, while "construction risk creep" may occur when innovation is requested by the contracting authority.

Sharing Responsibilities – Allocating Risk

In full accordance with common knowledge and theoretical underpinnings, projects were found to perform better when **risk management rules are respected**.

- **Construction risk** is typically allocated to the builder/supplier, who has, in principle, the ability to manage technical risk. However, less mature projects have a greater probability to encounter problems in design, permits etc. leading to **"risk allocation creep"**[38], as the contracting authority will be called upon to bear the impacts of risks that materialise (see findings in road and urban transit projects).

[37] See Annex 1 of this report and respective BENEFIT Deliverables: A.1.2.4; A.1.3; A.1.4; A.1.5.

[38] "Risk allocation creep" is a term introduced in this report to describe the process by which risk allocation is transferred gradually from private partner back to public partner, as the public partner is obliged to secure the completion/ operation of the infrastructure project, or through the effect of guarantees and other similar measures.

- It was found that **overestimated traffic forecasts are related to inappropriate demand risk allocation**. PPPs tend to be more conservative when appropriate demand risk is passed over to the concessionaire, especially in connection with the remuneration scheme implemented. In addition, **"risk allocation creep" also occurs during operation** by introducing revenue support and other risk mitigation measures or with the public sector setting pricing restrictions or price approval processes which effectively reduce the operator's incentive or responsibility.

In conclusion, **Project Maturity**, **Competences** of the parties involved, and the appropriate sharing of responsibilities (**risks)**, are the key conditions driving project performance with respect to the business model[39].

Notably, Project Maturity refers to both technical and business maturity, including but not limited to:

- Technical Maturity:
  - Sound technical/engineering design detail (minimum technical risks)
  - Availability and/or ability to obtain in a timely manner all required permits (land availability, building permits, environmental permits etc.)
  - Proper knowledge of ground and other conditions affecting project construction (foundation, archaeology etc.)
  - Life cycle planning
  - etc.
- Business Maturity:
  - Justification of project need and scope
  - Unbiased demand forecast
  - Stakeholder acceptability (pricing, delivery type etc.)
  - etc.

Under the above conditions (Project maturity, competences, appropriate sharing of risks), projects demonstrating **"high level of control/coopetition"**, **"combined services"** and "**multiple revenue streams**" may perform better, also under adverse macro-economic conditions. Innovation is also important but heavily dependent on maturity and competences.

3.2.4 Governance

Efficient/effective and flexible Governance, which includes competitive tendering and contracting arrangements which support reduction of transaction costs, the ability for Pareto amendments, formal mechanisms of project governance, also expressing flexibility, were identified as an important contribution in the achievement of project management goals. Notably, **efficient/effective and flexible governance is related to national stable and high quality institutions**, even though, as identified in the study, there could be efficient/effective and flexible governance even in cases with less stable and of less quality institutions. Furthermore, it was found that efficient/effective and flexible governance may also compensate for deficiencies of institutions. In this context, projects characterized by efficient/effective and flexible governance are also better equipped to **withstand fluctuations in national productivity and competitiveness**. Finally, the relation between **efficient/effective and flexible governance and the competence of the public contracting authority** should not be overlooked, as the probability of good governance increases when a competent contracting authority is involved.

Contract duration is important in PPP projects, as apart from other issues, it defines the public policy restrictions with respect to a particular infrastructure for the specified duration. However, most PPP projects in the sample, regardless of mode or investment size or expected returns, concerned contractual periods in the range of 30 years. While, information on the respective decisions was not available, it seems that a

[39] See Annex 1 of this report and respective BENEFIT Deliverables: A.1.2.4; A.1.3; A.1.4; A.1.5; A.1.6; A.1.7; A.1.8; A.1.9; A.1.13; also indicator analyses (fsQCA, IA, econometric models – A.1.10; A.1.11; A.1.12) as the above are considered in the CSI indicator.

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"rule-of-thumb" rather than a specific decision process was followed. An exception was a number of urban transit projects as well as projects from specific countries which endorsed a 7-year contractual period.[40]

3.2.5 Funding and Financing

A key issue when referring to financing schemes employed to deliver projects is their relative cost of financing. This element was not studied in BENEFIT, as a priori this was considered unachievable due to lack of access to the necessary information. The project was, therefore, structured so as not to require this information. Moreover, the **BENEFIT Matching Framework addresses PPPs and Publicly Financed projects uniformly in terms of their underlying financing arrangements**, as they both use the same types of capital, i.e. private equity, private debt and public (government) funds in different combinations.

A project's **financing structure is expressed through the Financing Scheme Indicator**, which is based on an adjusted WACC (weighted average cost of capital) in order to include the cost of public resources. Configured as 1-$WACC_{adj}$, FSI →1 describes projects with a higher contribution of financing from the public sector, with FSI=1 representing a project fully financed by the public sector. Conversely, projects financed by the private sector are expected to have FSI →0.

The overview of the Financing Scheme Indicator (FSI) values in the analysis sample presents an interesting observation:

The majority of projects identified as PPPs bear values of FSI >0.7 indicating that these projects are being heavily supported by the public sector. In effect, many PPP projects present FSI values which are rather similar to publicly financed projects. The observation suggests that significant public co-financing is needed in order to achieve private financing viability (risk premiums, profit and opportunity costs) and address risk averseness leading to **PPP financing structures that are not very different from publicly financed projects**. However, these PPP projects carry higher costs of financing in absolute terms.

Notably, the theory behind PPPs suggests that value for money is achieved through improved managerial skills employed by the private sector and other value adding characteristics. However:

- **There was no clear evidence that PPP performance was better than that of public projects with respect to cost and time targets**. Cross tabulations showed that PPPs were more likely to meet cost targets. Econometric models showed that PPPs underperformed in terms of cost and time to completion in comparison to publicly financed projects, even though their performance improved after the crisis. The road sample analysis showed road PPPs (especially brownfield ones) to be performing relatively better with respect to cost to completion; however, greenfield publicly financed road projects also performed well.

  The above observations may be **related to project maturity** rather than to the financing scheme.

  In addition, the synthesis of indicator analyses findings concluded that there are **strategic trade-offs taking place between cost and time outcomes**. It was observed that projects with a **high contribution from the public sector seek to complete "on-budget"**, while when **private financing is dominant there is an increased effort to complete "on-time"**. This trend is further incentivised when demand-based remuneration schemes were involved.

- **Publicly delivered projects perform equally well compared to PPPs with respect to traffic targets** when considering **a well-justified infrastructure in terms of scope, exclusivity and network integration**. In addition, projects with **low-risk income streams** (potentially not relying on user charges) seem to perform relatively better. This holds true for PPP and public projects alike.

[40] See Annex 1 of this report and respective BENEFIT Deliverables: A.1.2.2; A.1.2.4; A.1.3; A.1.4; A.1.5; A.1.6; A.1.7; A.1.8; A.1.9; A.1.13.

However, in **PPPs there is a tendency to pass more risk over to the concessionaire without** taking into account the project's "**Level of Control/ Coopetition"** (which reflects how manageable demand might be) and the **concessionaire's expertise**.

While appropriate allocation of demand risk has shown that conservative traffic estimates are forecast[41], misappropriate demand risk allocation has the opposite results.

Therefore, **there is no clear evidence that PPPs perform better with respect to cost and time to completion or traffic targets.** On the contrary, such performance seems to be associated with the Business Model (project maturity, competences and proper risk sharing) rather than the financing scheme.

With respect to revenue targets, in the case of PPPs, project structure is adjusted in cases of distress through renegotiations to match needs. This is demonstrated through:

- **"Risk allocation creep",** as described previously, leading to greater contribution of the public sector in the project financing structure. Notably, when revenue risk is appropriately allocated (operator with respective experience and well-positioned infrastructure), pure PPP financing schemes (FSI<0.5) are observed.

- Increase in tariffs/user charges or introduction of demand-based remuneration schemes **regardless of the users' willingness to pay** (WTP) as the key **objective is to cover costs.**

Again, based on the above **there is no evidence that PPP projects show improved performance with respect to securing revenues and project income**. On the contrary, public co-financing is many times introduced to support their financial viability.

3.2.6 Impact of the Financial Crisis

The global financial crisis (GFC) exposed the limitations of many transport infrastructure projects. Projects of lesser maturity; lesser national interest; low level of exclusivity and connectivity to the transport network; poor governance; demand-based remuneration schemes; and other limiting factors demonstrated poor performance with respect to all project targets, including cost and time to construction completion.

Notably, some infrastructures are better positioned to take advantage of business model characteristics that might support resilience against the impact of the crisis. For example, in theory, bridge and tunnel projects may demonstrate a high level of exclusivity and connectivity in the transport network; airports may take advantage of value-adding activities and services; port operators, depending on their international business, may have the ability to manage the supply chain etc. In all cases, however, technical maturity, the competence of the parties involved, including the contracting authority, and the appropriate allocation of risk will be decisive. Evidently, some transport infrastructures (e.g. road infrastructure projects) are more vulnerable as some of the above-mentioned positive characteristics are not always applicable.

In addition, **efficient/effective and flexible (good) governance**, especially in times of crisis in terms of competence (institutional and other) is important for both PPP and traditional delivery of infrastructure. Good governance also includes flexibility in terms of including **contracting arrangements** that allow for adaptation to sudden and unpredictable severe changes in the projects' surrounding (e.g. to GFC).

The above **characteristics**, which present "resilience" to the impacts of the crisis or a slowdown of the economy, concentrate on the transport infrastructure's ability to secure revenues and demonstrate lower levels of risk (allowing for low cost financing[42]) thus **bearing the ability to cover costs**.

[41] Projects meet their traffic targets.

[42] Low cost financing schemes for debt include, for example, loans from international financing institutions, multilateral banks, national and international development banks. Using low cost financing may improve the investment's coverage at a lower cost and reduce the service of the debt contracted with the private operator (i.e., commercial bank).

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When **project characteristics are not favourable**, then a number of **measures may be taken to strengthen cost coverage**, although some may be considered **adverse with respect to the overall justification** of the transport infrastructure project.

In effect, cost coverage may be achieved by:

- Reducing operational costs (OPEX). Ultimately this usually leads to reduced maintenance (also due to the increase in maintenance material costs) for all transport modes and reduced service provision (see urban transit) initiating a downward infrastructure service quality spiral.

- Increasing user/tariff charges. The measure may lead to further reduction of demand depending on willingness to pay but the objective is to strike a balance that would address the issue of cost coverage.

- Increase public sector contribution to project financing in the case of PPPs. The objective is to contribute financing of lower cost of capital. However, this approach places further strain on already over-stretched public budgets and challenges the initial decision for PPP delivery which in most cases concerned employing private financing to substitute public financing.

- Reducing the scope of the project, when still under construction. The approach reduces exposure but has an adverse effect on the anticipated benefits of the projects.[43]

- Extending the contractual period of PPPs. The approach effectively passes over to the private sector the issue of short term cost coverage. The approach could be considered acceptable if the recession period is expected to be relatively short and if the concessionaire has an adequate project portfolio allowing the sharing of resources. [44]

In addition, significant changes were observed with respect to new PPP deals in Europe following the 2008 year-mark. These are summarised below:

- The dominant funding scheme has shifted from demand-based to availability-based.

- New countries with high institutional capacity and positive macro-economic projections have entered the market.

- Countries typically present and seeking additional finances to put forward infrastructure programmes have reduced their participation or even exited the market.

The above observations **question the initial raison d'être of the PPP procurement model,** especially as many PPPs are heavily supported by the public sector**,** in its present form and its ability to address transport infrastructure financing gaps. The corresponding lesson from the present study is that transport infrastructure project performance, in terms of cost and time to completion and traffic and revenue forecast attainment, is rather **independent of the financing scheme**, as **the conditions of improved performance are mostly related to the actual project characteristics and the competences of the involved parties**, including in all cases the public contracting authority and the **appropriate sharing of responsibility** (risks) amongst the involved parties.

Notably, the implementation context (macro-economic conditions, country competitiveness, political, regulatory and institutional stability and quality) are beyond the control of project decision-makers (exogenous to the project), while exerting significantly influence on project performance. However, **actionable factors exist** (endogenous to the project) that may be influenced by decision makers (as above), including **governance**, through which, the institutional setting of the project may be improved. With respect to actionable factors, project decision-makers are **limited by the inherent ability of different infrastructure modes to be influenced by such factors**.

[43] See Annex 1 of this report and respective BENEFIT Deliverables: A.1.3; A.1.4; A.1.7.

[44] See Annex 1 of this report and respective BENEFIT Deliverables; A.1.2.2; A.1.3; A.1.7;

3.3 Lessons Learnt based on the BENEFIT Matching Framework[45].

3.3.1 Introduction

As described in Chapter 2 of the present report (Background), the BENEFIT Matching Framework models transport infrastructure project delivery and operation through a set of composite indicators. By employing the BENEFIT Matching Framework indicators, a more systematic and quantitative analysis of the BENEFIT set of project cases is achieved. Lessons are presented herewith in the context of BENEFIT indicators and their interpretation. The synthesis of findings distinguished the BENEFIT Matching Framework indicators into two categories (see Figure 3.3.1):

- **Exogenous Indicators**: These include the Financial-Economic indicator (FEI) and the Institutional Indicator (InI). These indicators describe the implementation context. The decision maker of a specific project has no influence over these indicators and their values.

- **Endogenous Indicators**: All other indicators fall under this category. This category is also divided into the following two groups:

    - **Structural Indicators**: These describe the business model and the contractual conditions of implementation (IRA, CSI, RSI and GI). Notably, following project award, the flexibility and, therefore, the range of possible available decisions gradually becomes limited.

    - **Policy Tool Indicators**: The values of these indicators may be changed throughout the life cycle of the project (RAI, RRI and FSI) based on corresponding decisions. These indicators, in combination with other indicators and for specific values of the indicators combined, have the ability to drive particular aspects of project performance. In this context, project decision makers may exercise policy and strategy.

      Furthermore, the structure of the FSI allows for new financing instruments to be tested.

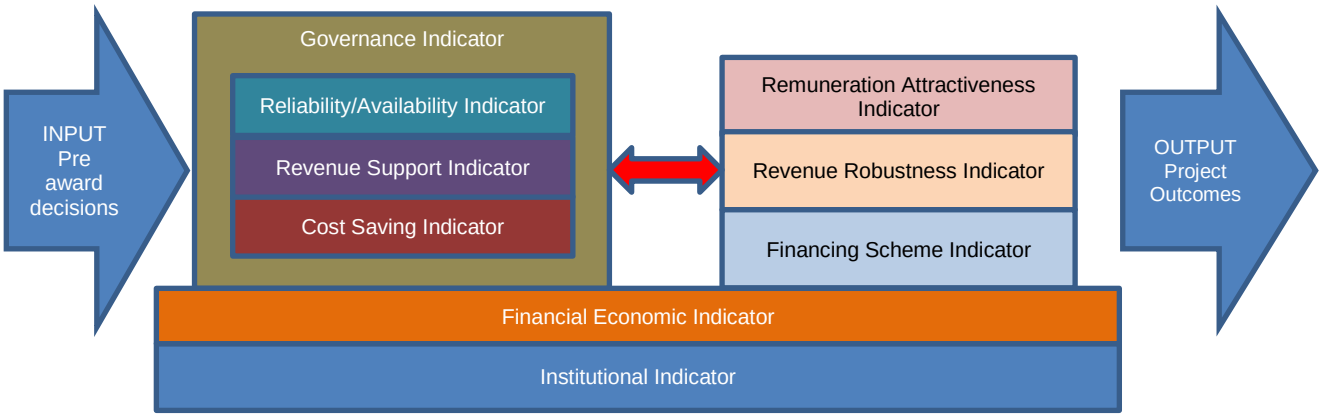

Figure 3.3.1: BENEFIT Matching Framework: Figurative relation between indicators

Notably, while the outcomes of transport infrastructure projects are influenced by factors outside the managerial ability of the parties involved, there are many other internal project factors that may be addressed to improve their potential of achieving expected outcome targets. Further to this remark, it is also interesting to note that three of the endogenous indicators namely, Remuneration Attractiveness, Revenue Robustness and Financing Scheme Indicator, may be considered “policy indicators” as they drive project outcomes differently according to their values. This is in contrast to the other internal indicators for which, when important, low values are typically associated with negative outcomes.

[45] See BENEFIT Deliverable D3.2.

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General lessons learned are presented in the following with respect to implementation context, project structure-related and policy tools-related indicators and their combinations. Brief lessons per transport mode follow.

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3.3.2 General Lessons Learnt

Implementation Context Indicators

Lessons learnt with respect to the implementation context are:

- The implementation context, and more so the financial-economic conditions, are known to influence traffic and revenue outcomes in transport infrastructure projects. Recent reports indicate that **a poor implementation context** (poor productivity, less stable/quality institutions) may equally **have a negative impact on the potential to achieve cost and time-to-completion targets**.

- While the financial-economic (productivity) conditions have a significant impact on transport infrastructure project outcomes, **a strong institutional context** (stable and of high quality national institutions) **may limit or even cancel the effect of poor financial-economic conditions** (productivity). To this end, countries with stable institutions are more capable of "surviving" a financial-economic crisis. Strengthening, therefore, of institutions, as they are described in through the respective BENEFIT indicator, is highly recommended.

- **For some modes and outcomes, low values of the Institutional indicator can be compensated by high values of the Governance indicator**[46] while, oppositely, a high Institutional indicator value can compensate for a low Governance indicator. Therefore, an effective and flexible transport infrastructure contract may compensate for relatively less stable institutional context conditions and in extension may limit the impact of poor financial-economic conditions (productivity). Consequently, contractual effectiveness and flexibility are recommended, especially in marginal positive (or negative) implementation environments.

Structural Indicators

Stemming from the synthesis of findings of all analysis conducted, the **combination of the Governance, Cost Saving and Revenue Support Indicators appears to influence the likelihood of attainment of most project outcome targets.**

While outcomes for these indicators will be supported as their values tend to the higher end of the spectrum (Indicator value = 1), structural limitations may not always allow for this to happen. This is particularly true in the case of the Revenue Support indicator. More specifically:

- Not all infrastructure modes display the potential of increased exclusivity or of business development.
- Not all infrastructure modes have the same potential of exploiting additional non-transport revenues or of being bundled with other development activities.

Despite this fact, it was noted that even for infrastructure projects which may benefit from their wider integration both in the transport network as well as the relevant urban environment (e.g. urban transit), little advantage was taken of this attribute. In this context, the **Revenue Support Indicator may be used as a proxy of project integration**.

However, the bundling of activities in infrastructure projects, while positive, may also be the source of reduced effectiveness, as contracting authorities have a poor record with respect to managing and monitoring such projects (reflected in a lower value of CSI). Consequently, bundling of activities can only take place when sufficient training and support is offered to the contracting authority.

The capability of contractors (concessionaires, constructors, and operators) is important. Within BENEFIT, the assessment of their capability has been based on their market position (and therefore on their

[46]Contractual governance effectiveness and flexibility

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experience and financial strength). Larger (bundled) and integrated projects have higher complexity and usually require actors with high capabilities. However, these actors, as they are usually international businesses, are also vulnerable to global (but also isolated) financial-economic fluctuations.

As repeatedly reported in the literature, the allocation of risks between contractors and the public sector is of paramount importance. Within BENEFIT, the assessment of the suitability (and equity) of this allocation is made based on the capability of the party to which the risk has been allocated to manage it. Divergence from this rule reduces the value of the CSI and RSI indicators leading, in turn, to a reduced potential of achieving pre-specified outcome targets. According to BENEFIT findings, capability to manage a specific risk should be the guiding principle for risk allocation.

The Governance indicator (contractual effectiveness and flexibility) has systematically been identified to be associated with the achievement of outcome targets. Each renegotiation will, by default, reduce the effectiveness of governance. The only way to address this weakness is by including contractual flexibility. Moreover, most of the above elements are defined during the procurement process. This fact places additional emphasis on procurement.

Finally, the importance of a mature project design and preparation has also been consistently identified. Well-planned and well-justified projects have a greater likelihood of reaching pre-defined outcome targets and withstand financial-economic downturns.

As the project life cycle progresses, the only structural elements available for further manipulation are innovation and the integration of non-transport services and corresponding revenues. However, being able to harvest these elements requires a capable (experienced) contracting authority.

Policy Tool Indicators

As the project life cycle progresses, fewer alternatives for taking action remain at the disposal of decision makers. These include project elements that are included in the Remuneration Attractiveness (RAI), Revenue Robustness (RRI) and Financing Scheme (FSI) Indicators.

The analyses indicated that projects with FSI >0,60 had a greater potential of achieving project outcome targets. Notably, this range of values for the indicator corresponds to one of the following possible options:

- publicly financed projects (FSI =1); or
- projects heavily supported by the public sector; or
- projects with access to low cost financing.

As the need to support public budgets continues, the need to identify and structure low cost financing instruments becomes even greater.

In addition, it was noted that projects with larger values of the FSI (publicly financed or heavily supported by the public sector) tend to favour the achievement of cost over time targets, while the opposite was observed for projects with lower values of the FSI.

As expected, during and after the crisis, demand-based remuneration schemes have not been favoured. In many ways, this undermines the drive for private financing. The BENEFIT research has shown that demand-based remuneration schemes may be sustained during the crisis by projects that present high exclusivity in combination with other contributing indicators.

Finally, a high value of the RRI along with other contributing indicators will improve the ability of reaching revenue targets. If revenue sources are not increased, then the only alternative to increase the RRI is to adjust the cost to be covered by the revenues (increase of the cost coverage factor of the indicator). Ultimately this means reduction of operation/maintenance costs or reduction of project scope.

The effects of factors included in the Policy Tools Indicators on project performance should be carefully considered, especially during renegotiations, as their combined values lead to specific outcomes and, ultimately express the policy and strategy objective of the project decision makers.

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3.4 Lessons Learnt per Transport Mode

The present section brings together lessons learnt which are specific per transport infrastructure mode.

3.4.1 Road projects[47]

Across all projects the Financial-Economic indicator is influential more with respect to traffic outcomes but also with an impact on cost and time targets. A high Institutional indicator may limit the impact of a low Financial-Economic indicator. In this context, countries with high Institutional indicators are more capable of weathering a financial/economic crisis.

With respect to time to completion, while the Governance indicator is the one dominating the potential to achieve this outcome, a high Cost Saving indicator may compensate smaller GI values. Trade-offs between cost and time to completion have been found to take place. In PPPs there is also a trade off with respect to revenues and traffic, especially if high-risk remuneration schemes are in place. More specifically:

Indicators Exogenous to the project

- The Financial-Economic indicator (FEI) plays a significant role in road projects. An increase or decrease in the value of this indicator may have a respective impact on the probability of achieving Time to completion, Cost to completion and Traffic targets. The influence is greater with respect to traffic and lesser with respect to time to completion. A high value of the Institutional Indicator may off-set the impact of a low FEI on time targets. The FEI is not a determining indicator with respect to the revenue target.
- The Institutional Indicator (InI) may be the most important. While exogenous to the project, it is not affected by economic cycles and, therefore, describes a measure of resilience to financial shocks. It is a pre-requisite in achieving cost and time to completion targets, while a high value may also limit the impact of a low FEI on traffic. Once again, the InI is not a determining indicator with respect to the revenue target.

Indicators Endogenous to the project

- The Governance indicator reflects in many ways the level of institutional maturity in the country where the project is procured. In this respect, it may compensate and/or enhance the Institutional Indicator. As it describes the institutional arrangements within the project, it practically influences all project outcomes.
- The Cost Saving indicator describes the project's technical difficulty and also the capabilities of key project actors: the constructor's to construct, the operator's to operate, and the monitoring authority's to monitor the project in consideration. In addition, it assesses whether capabilities are aligned with the risk allocation among these actors. All these attributes were found to be important throughout the project life cycle. A high CSI may compensate for a lower value of GI with respect to cost to completion and may also contribute to off-setting the impact of a low FEI on traffic.
- The importance of the Revenue Support indicator is limited in road projects and depends on the criticality and exclusivity of the project in the network. A high value of the factor "Level of Coopetition" may have a positive impact on cost to completion and revenue targets.
- The Remuneration Attractiveness Indicator practically acts as a policy tool. Low values of the indicator will drive the attainment of time to completion targets. High values of the indicator will limit the effect of FEI on traffic and also support revenue targets.
- The Revenue Robustness Indicator expresses the riskiness of the project revenue streams as well as the estimated level of cost coverage. Therefore, it becomes a key indicator in assessing the potential of achieving revenue targets and also drives the project towards being "on-time".

[47] See BENEFIT deliverable D3.2

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- The Financing Scheme Indicator is also a policy tool as it becomes a response to adverse exogenous indicators. Low values of the FEI and InI dictate the need for higher values of the FSI. In other words, countries with low FEI and InI values are forced to increase public contributions to project financing structures or opt out of the PPP model for project delivery altogether.

3.4.2 Bridge and Tunnel Projects[48]

The Financial-Economic Indicator influences traffic and revenues as expected but to a lower extent than roads due to the **high Level of Coopetition that characterises these structures**. The influence of the crisis on cost and time to completion could not be assessed, as all projects in the BENEFIT database were completed before the crisis, with the exception of one case. It is reasonable to assume that indicators applicable to road projects are of equal importance during the construction phase for bridge and tunnel projects. Once again, the Cost Saving, Governance and Revenue Support indicators are important for all outcomes, with greater emphasis on the Revenue Support (including the Level of Coopetition) indicator as bridge and tunnel projects are usually designed with a low value of the Remuneration Attractiveness indicator.

Finally, the findings with respect to bridge and tunnel projects should be considered purely indicative given their small sample size in the BENEFIT database. Key Findings may be summarised as follows:

Indicators Exogenous to the project

- The Financial-Economic indicator (FEI) is an important indicator, as in the case of road projects. FEI will affect cost and time to completion targets and a high FEI is important in the case of a low Remuneration Attractiveness Indicator which is common in bridge and tunnel projects. However, in the case of bridge and tunnel projects the negative impact of a low and/or decreasing FEI may be offset by high values of other indicators (e.g. GI, CSI and RSI).
- The Institutional indicator (InI) may be, once again, the most important. While exogenous to the project, it is not affected by economic cycles and, therefore, describes a measure of resilience to financial shocks. It is a prerequisite in achieving traffic and revenue targets in the case of a low RAI.

Indicators Endogenous to the project

- **The Governance indicator reflects in many ways the level of institutional maturity in the country of project procurement.** In this effect, it may compensate and/or enhance the Institutional Indicator. A high value contributes to the “on-budget” and “on-time” targets. High values are a prerequisite in achieving traffic and revenue targets in the case of a low RAI.
- The Cost Saving indicator describes the project’s technical difficulty and also the capabilities of key project actors: the constructor’s to construct, the operator’s to operate, and the monitoring authority’s to monitor the project in consideration. In addition, it assesses whether capabilities are aligned with the risk allocation among these actors. All these attributes were found to be important through-out the project life cycle. A high value contributes to the successful attainment of “on-budget” and “on-time” targets. High values are a prerequisite in achieving traffic and revenue targets in the case of a low RAI.
- The Revenue Support indicator is highly important for bridge and tunnel projects, especially its factor “Level of Coopetition”. It describes the exclusivity of the project in the network and a high value has a positive impact on all outcomes.
- The Remuneration Attractiveness Indicator is typically low in bridge and tunnel projects as the relative high “Level of Coopetition” allows the public sector to pass demand risk to the operator. A low RAI is a driver towards achieving time to completion. The Revenue Robustness indicator has the same effect with respect to achieving time targets. A low RAI may counterbalance a high RRI and vice versa.
- The Revenue Robustness Indicator expresses the riskiness of the project revenue streams as well as the estimated level of cost coverage. For bridge and tunnel projects it has the same effect as RAI, i.e. it drives time to completion.

[48] See BENEFIT deliverable D3.2

- The Financing Scheme Indicator was typically found to be high in all bridge and tunnel cases of the BENEFIT database. A high value of the FSI contributes to achieving project outcome targets.

In conclusion, as it was also identified by the qualitative analysis, Bridges and Tunnels could be considered as special cases of road (and also rail) projects with much higher exclusivity, which allows them to attain low RAI values (high risk remuneration schemes such as tolls). As these are usually projects of high technical difficulty, their ability to reach construction phase objectives is dependent, in addition to design maturity, on the expertise of the contractors/concessionaires.

3.4.3 Urban Transit Projects[49]

What is noticeable is that in order to secure positive outcomes all indicators identified have to exhibit high values. This is particularly important in order to achieve the cost to completion target. Some flexibility was identified with respect to the combination of the influence of the Cost Saving and Governance Indicators. More specifically, a lesser value of the Governance Indicator may be compensated by a greater value of the Cost Saving indicator. Finally, the Econometrics analysis identified the Reliability/Availability indicator (IRA) as significant in achieving ridership and revenue targets.

Key Findings may be summarised as follows:

Indicators Exogenous to the project

- The Financial-Economic indicator (FEI) whether describing the national context, as in the BENEFIT approach, or the local conditions, is not decisive for urban transit projects as the effect of a low or decreasing FEI (recession) may affect ridership positively or negatively (or both). The only definite negative effect FEI may have is on the amount of revenues from advertisements, which is a common income stream for urban transit.
- The Institutional indicator (InI) may be the most important. While exogenous to the project, it is not affected by economic cycles and, therefore, describes a measure of resilience to financial shocks and also transparency with respect to project maturity. It is a prerequisite in achieving all target outcomes.

Indicators Endogenous to the project

- The Governance indicator reflects in many ways the level of institutional maturity in the country of project procurement. In this effect, it may compensate and/or enhance the Institutional Indicator. A high value contributes to the “on-budget” and revenue targets. High values may also compensate for low values of the CSI for “on-time” and traffic targets.
- The Cost Saving indicator describes the project’s technical difficulty and also the capabilities of key project actors: the constructor’s to construct, the operator’s to operate, and the monitoring authority’s to monitor the project in consideration. In addition, it assesses whether capabilities are aligned with the risk allocation among these actors. All these attributes were found to be important through-out the project life cycle. A higher value of the CSI may compensate for a lower value of GI with respect to time to completion and traffic targets.
- The Revenue Support indicator is highly important in urban transit. It describes both the exclusivity of the project in the urban transit network as well as its ability to generate revenues from other sources. However, within urban transit the most important factor is “Level of Coopetition”.
- The Remuneration Attractiveness Indicator is always relatively high in urban transit as most operations are subsidised. Higher values of the indicator correspond to greater public support and consequently less expensive fares driving both ridership and revenues for the project.
- The Revenue Robustness Indicator expresses the riskiness of the project revenue streams as well as the cost coverage level estimated. Therefore, it becomes a key indicator in assessing the potential of achieving revenue targets.

[49] See BENEFIT deliverable D3.2

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- The Financing Scheme Indicator was not found to have a particular impact on outcomes most probably because urban transit is usually heavily supported by the public sector. This support is mostly reflected in the Remuneration Attractiveness Indicator.
- Finally, while a high Reliability/Availability Indicator is important for all modes, it is a prerequisite for traffic and revenue targets in urban transit projects.

3.4.4 Airport Projects[50]

The small sample of airport projects included in the BENEFIT database limits the explanatory power of the analysis as well as the ability to generalise conclusions**.** Findings from the quantitative analyses were compared to the qualitative analysis as well as the existing literature.

As in the case of other transport infrastructure, the Cost Saving and Governance Indicators are important in achieving cost to completion targets. Revenue Support also seems to be contributing positively. The same indicators are also important in order to achieve time to completion targets. Traffic is influenced by the implementation context but also by the way the airport is connected to the local/regional or national economy. Incentives connected to demand risk allocation are also important.

Contrary to the findings of the quantitative analysis, revenue targets are not directly impacted on by the Financial-Economic indicator. For this outcome Revenue Support, Revenue Robustness, Cost Saving and Governance are the indicators that drive positive results. Notably, the Remuneration Attractiveness indicator is typically low in airport projects.

Key Findings are presented below. However, due to the small sample size, they should be handled with care.

Indicators Exogenous to the project

- The Financial-Economic indicator (FEI) is an important indicator. For airport projects, a high value of the indicator will have a positive impact on cost and time to completion. However, when it comes to traffic and revenue targets, the wider financial-economic context should be considered depending on the business scope of the airport.
- The Institutional indicator (InI) may be the most important. While exogenous to the project, it is not affected by economic cycles and, therefore, describes a measure of resilience to financial shocks.

Indicators Endogenous to the project

- The Governance indicator reflects in many ways the level of institutional maturity in the country of project procurement. In this effect, it may compensate and/or enhance the Institutional Indicator.
- The Cost Saving indicator describes the project's technical difficulty and also the capabilities of key project actors: the constructor's to construct, the operator's to operate, and the monitoring authority's to monitor the project in consideration. In addition, it assesses whether capabilities are aligned with the risk allocation among these actors. All these attributes were found to be important through-out the project life cycle. The Revenue Support indicator is highly important for airport projects both with respect to its factor "Level of Coopetition" as well as the consideration of alternative sources of revenue. A high value of the indicator contributes to all four outcomes.
- The Remuneration Attractiveness Indicator is typically low in airport projects as the relative high values of "Level of Coopetition" allow the public sector to pass demand risk to the operator. A low RAI is a driver in achieving time to completion. The Revenue Robustness indicator has the same effect with respect to achieving time targets. A low RAI may counterbalance a high RRI and vice versa.
- The Revenue Robustness Indicator expresses the riskiness of the project revenue streams as well as the estimated level of cost coverage. For airport projects it has the same effect as the RAI, i.e. it drives time to completion. Additionally, it is important in assessing the ability to achieve traffic and revenue targets.
- A high Financing Scheme indicator was found to contribute positively to cost and time to completion targets.

[50] See BENEFIT deliverable D3.2

3.4.5 Port projects[51]

The prominent feature of the port cases is their uniqueness with respect to outcomes. A dominant condition in achieving cost and time to completion, in accordance with the quantitative analyses findings, are high values of the Cost Saving, Governance, Revenue Support and Institutional indicators. However, very importantly, positive outcomes may be reached even if these conditions are not met. Notably, these BENEFIT indicators need to be adjusted for the port sector. For example, the CSI with respect to construction is now assessing SPV competence. A future adjustment may involve the assessment of the sub-contractor builder.

Considering the above, it is possible that the BENEFIT Matching Framework cannot be applied to port infrastructure as trade-offs between cost and time to completion are affected by strategic behaviour.

Strategic behaviour seems to also influence traffic and revenue outcomes (see Deliverables D4.2 and D4.4). In effect, port traffic is dependent on the international strategies of shipping lines and hinterland connections (logistic supply chains), which in order to be captured by the BENEFIT framework would need to have the Level of Coopetition factor expressing the uniqueness of the port in the internal logistic networks that it serves.

Finally, the financial–economic context continues to be important. However, once again, it should not refer to the national context of the country where the port is positioned but to the logistic chains it serves.

3.4.6 Rail Infrastructure Projects[52]

With respect to their construction, rail projects have a combination of high profile and technical risks equal or even greater than those observed in special structures (bridge and tunnel Projects). Simultaneously, as opposed to special structures they are not characterised by exclusivity and, therefore, they cannot take advantage of their position in the network to employ the project structure characteristics of bridge & tunnels, i.e. low value Remuneration attractiveness indicator. They do, however, employ high values of the Financing Scheme Indicator.

In addition, while their Revenue Support Indicator with respect to position in the network is relatively low (low exclusivity) other features can provide a high Revenue Support indicator such as business orientation, other transport related and non-related services. Notably, the bundling of services while positive for revenue prospects places pressure on both the Governance Indicator and the Cost Saving Indicator with respect to the capability of the contracting authority. In addition, the Institutional Indicator is important, also, in this context.

Stemming from the above, while the initial tendency would be to approximate rail infrastructure projects to other linear infrastructures, the behaviour with respect to indicators points research to urban transit projects.

[51] See BENEFIT deliverable D3.2

[52] See BENEFIT deliverable D3.2

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3.5 Concluding Remarks

It is clear that the number, mode and country distribution, and level of detail of the project cases captured in the BENEFIT database have defined the boundaries of what the BENEFIT project could achieve analytically. Although the analysis sample has its size limitations, the combined expertise and analytical background of the BENEFIT team was able to mitigate its impact by introducing a multi-analysis approach. This approach also compensated for limitations that each individual analysis approach may have through the comparative treatment and synthesis of their respective findings. These efforts lead to the following concluding remarks.

Transport infrastructure project performance is rather **independent of the financing scheme**, as **the conditions of improved performance are mostly related to the actual project characteristics and the competences of the involved parties**, including in all cases the public contracting authority and the **appropriate sharing of responsibility** (risks) amongst the involved parties.

While, the implementation context (macro-economic conditions, country competitiveness, supporting policies, regulatory frameworks and institutions) is beyond the control of project decision-makers (exogenous to the project) and may significantly influence project performance, there are also **actionable factors** (endogenous to the project) that may be influenced by them. One such actionable factor is governance**.** The **quality of project governance** may reduce or improve the effect of **institutional support.**

Actionable factors may be categorised as structural and policy. Structural factors are mostly defined during the project's planning, tendering and award stage (project maturity, business model and contractual conditions/configuration). Their improvement improves the potential of achieving project targets. Policy factors (financing structure, project income (remuneration scheme) and project revenue streams) are actionable throughout the project life-cycle and induce trade-offs with respect to the achievement of project outcomes.

The above explains why a **project's funding and financing schemes were not found to be decisive factors in the achievement of project outcome targets.**

Each transport infrastructure mode is influenced differently by the implementation context and different factors contribute in each case in achieving the respective outcome targets. The difference lies primarily in the ability to fully endorse factors identified to support the achievement of project outcomes.

In addition, it was found that:

- There is **no single factor** that can define the likelihood of achieving an outcome target but rather **combinations of them**;
- There is **no single combination of factors** that can secure the successful attainment of all project outcome targets simultaneously;
- **Outcome targets are not achieved by the same combination of factors across all modes** of transport.

Finally, with respect to the frequently mentioned issue of information sharing, it was found that it is not only related to operational confidentiality and/or international business information disclosure ethics. It is also a matter of systematic recording of data concerning not only PPP (or generally privately co-financed) projects, but also projects financed by the public sector, for which even less information is available. The issue is rather related to **lack of systematic data archiving and registering** than information disclosure issues. The ramification is the inability to capitalise on existing experience and exploit relevant data.

4 BENEFIT Policy Guiding Tool: Transport Infrastructure Resilience Indicator & Rating Methodology[53]

4.1 Introduction

The BENEFIT Policy Guiding Tool is founded on the use of a new indicator, entitled Transport Infrastructure Resilience Indicator (TIRI). In the context of BENEFIT, resilience is defined as *"the ability of a transport infrastructure project to withstand, adjust and recover from changes within its structural and implementation elements with respect to its ability to deliver specific outcomes (such as cost and time to completion, expected traffic and expected revenue targets)".*

The Transport Infrastructure Resilience Indicator bears the following characteristics:

- System Boundaries: The system in focus is described by the BENEFIT Matching Framework[54] and is reflected by its endogenous and exogenous indicators.

- Figure-of-Merit: The TIRI rating is provided per project outcome. The model considers four "Figures-of-Merit" with respect to system performance: Cost-to-Completion; Time-to-Completion; Actual vs. Forecast Traffic; and Actual vs Forecast Revenue. As expected, the system may exhibit simultaneous resilience for one or more figures-of-merit, but not necessarily for all. The combined assessment of the TIRI rating to produce an overall project assessment is left to the individual stakeholder, as this overall assessment is considered stakeholder-specific and corresponds to the interests of each individual stakeholder. Methodological approaches for producing an overall assessment are offered elsewhere in BENEFIT deliverables.

- Actionable Variables and Background Conditions: The Transport Infrastructure Resilience Indicator (TIRI) rating is structured by clearly differentiating between endogenous and exogenous indicators. In the developed rating system, it becomes immediately obvious which indicators need to be addressed in order to improve resilience. Notably, amongst the system indicators, the Financial Economic Indicator (FEI) and the Institutional Indicator (InI) are considered exogenous to the project as they affect the project but cannot be influenced by its stakeholders. All other indicators are considered endogenous as, while they also affect project performance, actions may be taken in order to influence the sign of their impact. Moreover, they may also be used to address negative effects from the exogenous indicators.

- System Stability: It is acknowledged that the system will change over time, especially as a response to involuntary changes in the exogenous indicators. In this context, it is not enough to provide a TIRI rating reflecting current conditions (Static Transport Infrastructure Resilience Indicator, S-TIRI). This indicator needs to be accompanied by an indication of potential resilience to change. To this end, the methodology also includes a Dynamic Transport Infrastructure Resilience Indicator (D-TIRI).

- Accuracy and Transparency: The rating methodology proposed is systematic, consistent and does not require a qualitative assessment or subjective interpretations. Therefore, the resulting TIRI ratings (Static and Dynamic) are both reproducible and easy to verify.

The synthesis of all analyses conducted within the BENEFIT project and their respective findings and conclusions form the foundations of and provide the guidelines for the application of the TIRI rating methodology.

The synthesis of findings in tabular format per transport infrastructure mode and outcome are included in **Annex 2** of the present report. The TIRI rating methodology, its applications and its potential as an ex-ante scenario building tool, current development stage limitations, and recommendations for further development are presented in this Chapter.

[53] See BENEFIT deliverable D3.2

[54] See BENEFIT Deliverable D3.1

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4.2 The Transport Infrastructure Resilience Indicator Rating System

The Transport Infrastructure Resilience Indicator comprises three basic rating categories, namely A, B and C. It is noted that the **suggested TIRI ratings** are **not** a comprehensive assessment of a project. They present **a forward-looking estimation** of a project's potential to achieve certain outcome targets.

The TIRI rating categories are specified as follows:

- **Rating A:** projects have a high likelihood of reaching a specific outcome target as they demonstrate a well-structured business model (indicators IRA, CSI, RSI and GI), and policy decisions (indicators RAI, RRI and FSI) are supportive within a positive implementation context (FEI and InI).

- **Rating B:** Under this category projects may be characterised as B_{EX} or B_{EN} depending on the source of vulnerability. More specifically:

    - **Rating B_{EX}:** projects have an average likelihood of reaching a specific outcome target as they demonstrate a well-structured business model (indicators IRA, CSI, RSI and GI), and policy decisions (indicators RAI, RRI and FSI) are supportive **but** in a marginally positive implementation context (FEI and InI).

    - **Rating B_{EN}:** projects have an average likelihood of reaching a specific outcome target as they are implemented in a positive implementation context (FEI and InI) but lack a well-structured business model (indicators IRA, CSI, RSI and GI) and supportive policy decisions (indicators RAI, RRI and FSI).

- **Rating C:** projects have a poor likelihood of reaching a specific outcome target as they are implemented in a poor implementation context (FEI and InI) **and** lack a well-structured business model (indicators IRA, CSI, RSI and GI) as well as supportive policy decisions (indicators RAI, RRI and FSI).

Furthermore, due to the many indicators involved in determining each rating for each figure-of-merit and mode, slightly better or worse conditions may exist. These are presented with additional rating notches, (+) or (-) shown next to the basic rating, A, B or C. Table 4.2.1 summarises the range of potential values of the proposed rating system.

Table 4.2.1: Transport Infrastructure Resilience Indicator Rating System

Exogenous Vulnerability	Rating Category	Endogenous Vulnerability
None	A	None
None	A-	Some
Some	B_{EX}	Limited
Endogenous structure reduces vulnerability	B_{EX}+	Limited
Endogenous structure increases vulnerability	B_{EX}-	Limited
Limited	B_{EN}	Some
Limited	B_{EN}+	The combination of endogenous and exogenous conditions reduces vulnerability
Limited	B_{EN}-	The combination of endogenous and exogenous conditions increases vulnerability
Existing The combination of endogenous and exogenous conditions reduces vulnerability	C+	Existing The combination of endogenous and exogenous conditions reduces vulnerability
Existing	C	Existing

Following this rating system and in combination with indicator combinations leading to the likelihood of achievement of outcomes per mode, a detailed methodology addressing each mode and outcome was developed[55]. As per the combined conclusion of the multiple analyses, different combinations of indicators

[55] See BENEFIT deliverable D3.2

contribute in achieving the various outcomes per mode. Furthermore, the threshold value for each indicator to contribute to a specific outcome per mode was identified through further comparative analysis. The rating methodology per mode and outcome is included in **Annex 3** of the present report.

The proposed rating methodology leads to the assessment of the Static Transport Infrastructure Resilience Indicator (S-TIRI).

In order to define the level of "stability" of the S-TIRI, the **Dynamic Transport Infrastructure Resilience Indicator** (D-TIRI) is defined as the change in the Financial Economic Indicator (FEI) value leading to change in the S-TIRI rating and is expressed by two values:

- The first describing the percentile decrease needed to drop to the next lower rating category, i.e. from A to B or from B to C, and
- The second describing the percentile increase needed to move up a rating category, i.e. from C to B or from B to A.

The findings from the analysis (as also reflected in the rating methodology) identified that the FEI does not influence certain outcomes (e.g. Revenue for roads) and is not particularly influential for urban transit projects. In such cases, the ruling concept continues to be the change in category rating. However, the measure in these cases is the Institutional indicator.

The assessment of an **Overall Transport Infrastructure Resilience Indicator** (O-TIRI) is mostly an **expression of a particular stakeholder's point of view**, as it would reflect their own value system with respect to the relevant importance attached to achieving the different project outcomes. Two typical approaches in constructing the Overall Transport Infrastructure Resilience Indicator are:

- The Overall Transport Infrastructure Resilience Indicator is equal to its "weakest link", i.e. it is equal to the minimum of the ratings describing the four figures-of-merit (outcomes) considered in BENEFIT. However, in this approach the potential importance or ability of the "strongest link" to compensate for shortcomings is overlooked.

- The Overall Transport Infrastructure Resilience Indicator is equal to a weighted average of the four figures-of-merit considered in BENEFIT. The approach is then tailored to the needs of each stakeholder as the respective weighting applied would reflect the particular stakeholder's risk perceptions and interests.

Both approaches bear advantages and disadvantages and may be equally applied using either the Static or the Dynamic Transport Infrastructure Resilience Indicator. Combinations of the two approaches may also be considered while either of them may be applied for any project phase and at any time during the life cycle of the project.

Within BENEFIT, following a **stakeholder-neutral approach**, the O-TIRI is demonstrated as a sequential presentation of the S-TIRI of each outcome. Hence, an O-TIRI takes the form of a vector, for example, O-TIRI = {A, C, B_{EN}, B_{EN}+}, which simply states that for a particular project the Transport Infrastructure Resilience Indicator has attained the following rating scores:

- A with respect to reaching "Cost-to-Completion" targets,
- C with respect to achieving "Time-to-Completion" targets,
- B_{EN} concerning the achievement of "Actual vs Forecast Traffic" targets
- B_{EN}+ concerning the achievement of "Actual vs Forecast Revenue" targets

The TIRI rating system was applied to the **entire set** of BENEFIT case studies for which indicator values could be obtained and/or estimated. This set consisted of **57 cases**. The application aimed to serve as a calibration of the proposed methodology and provided **encouraging findings** with respect to its **ability to predict project performance**.

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4.3 Transport Infrastructure Resilience Indicator Rating Applications

There is **merit in assessing the potential** to achieve each outcome target, through the proposed TIRI ratings. These ratings can assist the various project stakeholders in determining the nature and extent of their involvement in the various project phases. For private parties this assessment may be related to corresponding **investment decisions** whereas for the public party it can help to better **allocate risks** or assess the influence **project structure decisions** may have on the project's potential of reaching specific outcome targets under various implementation context conditions. **Proposed financing schemes** may also be assessed as to their potential impact on project performance.

The TIRI may also be used to **monitor project "health"** during its implementation and **test various scenarios** of project structure and policy interventions.

In this section the application of the TIRI project monitoring is described, as an example of how to exploit the potential of the TIRI ratings over a project's life-cycle. In BENEFIT, based on this approach, scenarios were tested on existing cases leading respective conclusions with respect to the application of the TIRI rating methodology. These are also presented herewith.

4.3.1 Monitoring and Improving on Project Performance

Monitoring the infrastructure delivery system and improving on project performance is carried out by monitoring and taking actions to improve the project's rating. For each outcome, indicator combinations and their respective values formulate "tipping" points. More specifically, for each outcome (or the outcomes of interest to a particular stakeholder) the indicator values should be such that, **ideally, the rating is equal or higher to B_{EX+} or just B_{EX}**. This rating category secures that the **endogenous project indicators are such that the project has a significant likelihood of withstanding the impact of a relatively adverse implementation environment**. Additionally, both exogenous and endogenous indicators may change over the life time of a project.

While there may be little influence both decision makers and managers can exert over exogenous indicators, endogenous indicators are clearly within their sphere of influence. However, it is commonly known that the ability to influence endogenous indicators is reduced as the project development progresses. This places increased emphasis on the quality of decision-making at the front end of projects.

To this end, and in order to describe a process that can lead to higher project implementation resilience, the planning phase is taken as the starting point, presenting a stage during which a series of iterative investigations (**ex-ante scenario building and rating**) need to be undertaken to test for various scenarios of project structuring and implementation. Figure 4.3.1 illustrates the suggested process as described in this section which is also applicable to subsequent project phases, i.e. procurement, financial close, implementation as well as renegotiations.

The presentation which follows is generic and endogenous indicator combinations should be considered per outcome and transport infrastructure mode.

Planning Phase

<u>Exogenous Indicators: Implementation Context (FEI and InI)</u>
The analysis identified that projects delivered in an implementation context characterised by a Financial-Economic indicator of FEI<0.50 should be treated with extreme caution, since their likelihood of reaching specified outcome targets is severely diminished. However, if the Institutional Indicator has a high value (InI>0.65), then, a relative improvement of the odds is expected, especially if an increasing trend in the FEI is observed. The conditions for FEI are not compulsory for urban transit projects, while a high InI is important in this case.

<u>Endogenous Indicators: Structural (IRA, CSI, RSI, GI)</u>
This set of indicators reflects the project's structure. The design of the structure of the project together with input from all previous studies leads to the initial estimation of the corresponding indicators. Within this section, the Reliability/Availability (IRA), the Cost Saving (CSI), the Revenue Support (RSI) and the Governance (GI) indicators are considered.

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IRA is considered to be IRA=1 reflecting the reliability and availability of service. If, within the life cycle of the project, partial operation or staged inauguration is planned, IRA will take respective values over time.

CSI at the planning phase should reflect the actual conditions for its known parameters and assist in the investigation of plausible scenarios for those not known following the indicator estimation process. More specifically, the CSI considers in principle the following parameters: Technical difficulty, Constructor Capability, Operator Capability, Contracting Authority's Capability, Innovation, and Life cycle planning.

RSI is assessed based on the project's configuration in the transport network and the revenue sources initially planned. The indicator considers the following parameters: Level of Coopetition, Sources of revenues, and Quality of service/ user satisfaction per source of revenue.

GI is composed of two sets of parameters (or sub-indicators) concerning governance effectiveness/ efficiency and flexibility. It takes into account:

- The project's "needs" in capabilities as they are estimated in the construction of the CSI and RSI
- The preferred risk allocation
- The procurement laws and regulations applied in the contracting authority's respective level of government. At the planning stage, the minimum values of the parameters are set.

Endogenous Indicators: Policy Tools (RAI, RRI, FSI)
This set of indicators reflects project funding and financing arrangements.

RAI reflects the decision with respect to the potential streams of project income or the remuneration scheme associated with the risks each source of income may present and the coverage ratio potentially achieved. Normally, 100% cost coverage should be estimated at this stage although respective scenarios of lower coverage may also be developed.

RRI reflects the various sources of project generated revenues (connected to RSI) associated with their respective risk and the expected cost coverage that may be assumed. Again, 100% coverage should be estimated at this stage, but also respective scenarios of lower coverage may be developed.

FSI reflects the model of project delivery (Public or with Private Financing) as well as the potential structure of the financing in terms of cost of capital. Notably, at this stage, key scenarios may be tested: 100% public financing (FSI=1); strictly or the majority of the financing coming from the private sector (usually FSI<0,300); private financing with significant public support through guarantees, public contribution of financing etc. (usually FSI>0,600). The effect on FSI of innovative financing instruments can also be tested at this point.

Procurement

The analysis at the planning stage will define the procurement process, tendering documents and other minimum requirements so that the Governance indicator can achieve a value greater or equal to the one identified in the planning process. As corroborated by experience, all initial estimates generated during the planning stage will, more often than not, not materialise in practice. All endogenous indicators should then be re-calculated based on the contractual agreement terms and the capabilities of the actual actors involved (constructor, operator etc.) and the project be rated once again. If the rating is less than favourable, corrective actions need to be investigated. Notably, from this stage onwards, the flexibility of the structural indicators is reduced.

Financial Close

Reaching financial close will finally define the Financing Scheme Indicator. At this point it is worth estimating the project rating in order to identify the optimum synthesis of financing sources that would lead to an improved and stable rating. Notably, the value of the FSI has a different influence on the various outcomes and decision-makers would need to make an overall assessment based on their own interests and priorities.

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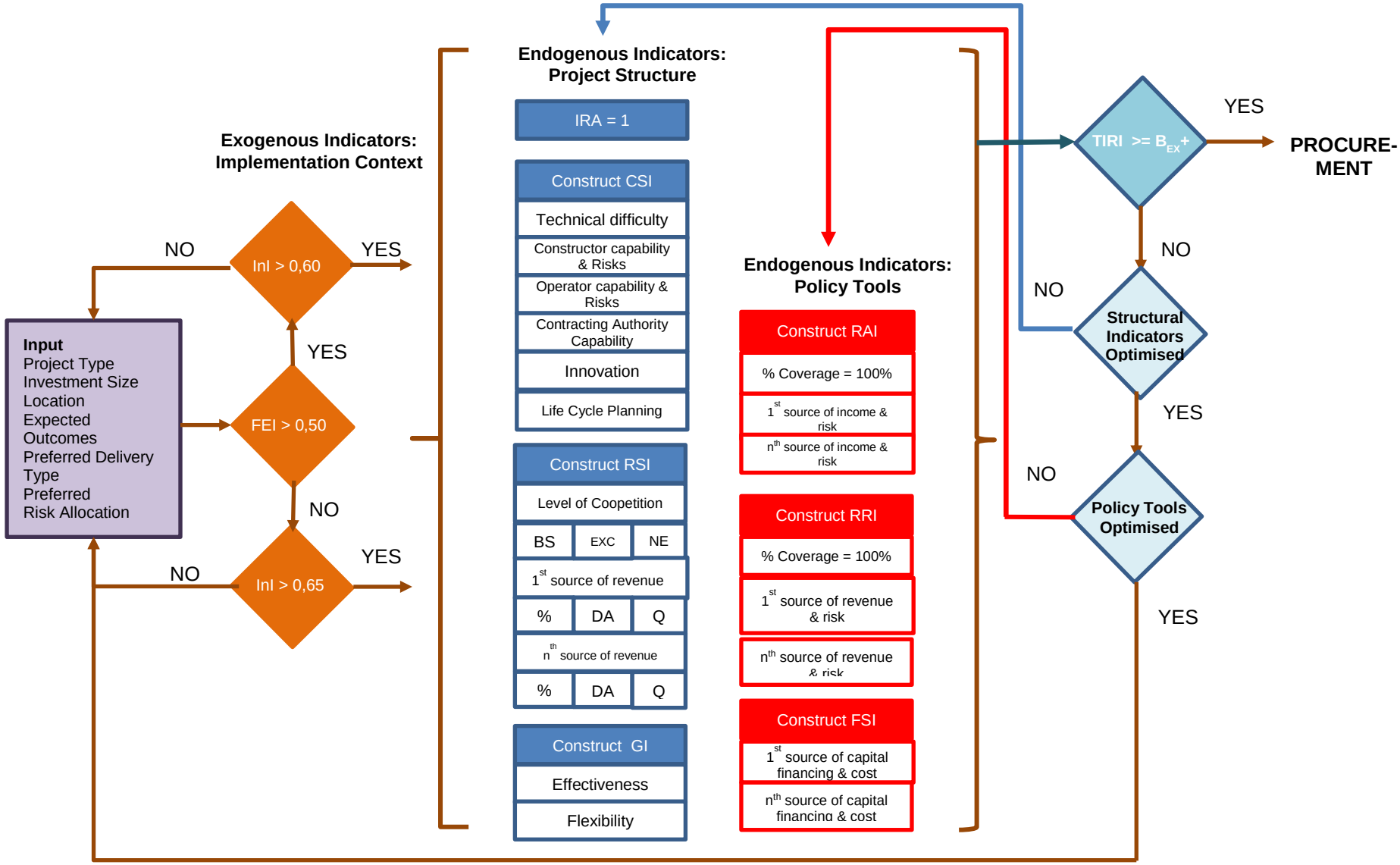

Figure 4.3.1: Schematic representation of iterative investigation process at the planning stage

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Implementation Phase

During the implementation phase, both exogenous and endogenous indicators may vary over time. More specifically:

- The implementation context (FEI and InI) may become more or less favourable;
- Contractual terms, especially with respect to risk allocation may be honoured to a greater or lesser extent (GI, CSI, RSI);
- Cost coverage and risks related to the income and revenues may vary (RAI, RRI);
- Financing sources and respective cost of capital may vary (FSI); etc.

The Transport Infrastructure Resilience Indicator rating will provide a measure of the project's stability and likelihood of reaching outcomes allowing for corrective actions or mitigation measures to be introduced. As noted previously, following project award and financial close, the project system becomes less flexible.

Renegotiations

The model may be applied to assess improvements that can be brought about during potential renegotiations. Notably, renegotiations should result in an improved project rating for individual outcomes of interest or all of them simultaneously. However, the anticipated challenge under a renegotiation setting is whether interests and priorities are aligned, as if this does not hold true, each party would be seeking the optimal settlement of its own individual interests which may not necessarily coincide with an overall optimal restructuring of the project. The use of the Transport Infrastructure Resilience Indicator rating could help identify such imbalances or misalignments of interests and help craft renegotiation solutions that are as close to the overall optimum as reasonably possible.

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4.3.2 Scenario Building Assessment of the Transport Infrastructure Resilience Indicator

The BENEFIT Policy Guiding Tool **was tested on 11 case projects** to assess the relevance of TIRI rating to inform policy-making. More specifically, TIRI ratings were employed to assess:

- Their ability to function as a scenario building tool by testing for different procurement options, implementation conditions, as well as funding and financing schemes during the planning and procurement stage. The evaluations also considered the potential to inform decisions in both the financial close phase of a project and the implementation phases.
- Their ability to monitor, predict project performance and assess the impact of adopting measures during the project life-time.
- The potential usefulness of the Policy Guiding Tool during renegotiations.

The TIRI was proven to be useful in the planning phase of transport projects. At this stage and in order to deliver a project according to cost, time, traffic and revenue expectations, projects could be set at their optimal potential conditions subject to existing constraints. Many, if not all, of the **factors** considered by the BENEFIT Matching Framework were **shown to be feasible of being implemented** in the 11 project cases analysed for the planning stage. This observation was **irrespective of each country's level of maturity of the different approaches of project delivery**.

The TIRI was useful in **identifying the most effective actions** to set in place during procurement and implementation phases. However, a number of factors are hampering an optimal implementation. These are factors bearing the influence of exogenous vulnerabilities (e.g. the business environment, the level of productivity, and the political stability of a country, amongst others), the little knowledge and adoption of cooperation-based approaches to project delivery (e.g. Public Private Partnerships), reliance on traditional procurement and transport business provision (instead of transport business development), and inappropriate country regulations.

In cases of **renegotiations,** common practice included the introduction of subsidies and the reduction of toll fares, the increase of fares and the modification of the service scope, and the extension of the time to delivery of the contract. Through the TIRI and the underlying BENEFIT Matching Framework various potential **alternative mechanisms could be proposed to improve performance**, such as the granting of incentives for performance, the reallocation of risks, and the allocation of other sources of revenue to the contractor.

Finally, it was confirmed that the TIRI could be **potentially employed as a monitoring instrument**. The TIRI rating may assist in predicting project performance and adopting measures during the project life in order to minimize adverse effects of the implementation context or exploit other relevant opportunities.

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4.4 Concluding Remarks and Recommendations for Further Development

4.4.1 Conclusions

Fulfilling its objective, the BENEFIT project developed a Policy Guiding Tool to guide decisions with respect to the delivery and operation of Transport Infrastructure Projects. It is generated from the composition of findings and lessons derived through the multiple analyses conducted on project case data and is based on the BENEFIT Matching Framework indicators.

The BENEFIT Policy Guiding Tool is operationalised through the Transport Infrastructure Resilience Indicator (TIRI) and its accompanying rating system and methodology. The TIRI is expressed in three (3) forms: Static (S-TIRI); Dynamic (D-TIRI) and Overall (O-TIRI).

- S-TIRI provides a rating based on the indicator values of the project at a time of interest per specific outcome.

- D-TIRI depicts the potential of change of the S-TIRI.

- O-TIRI is the combination of the S-TIRI or (D-TIRI) ratings to represent the overall rating of a project at a specific point in time. O-TIRI is stakeholder-specific as the relative importance of each outcome of the project for each stakeholder may differ. Typical approaches to the possible assessment of the O-TIRI are given. The BENEFIT project maintains a stakeholder-neutral approach and thus presents O-TIRI for illustrative purposes as a vector of the ratings of the four project outcomes considered.

The TIRI has been calibrated and has undergone preliminary testing. In its current state of development it is able to provide ratings for all outcomes in the case of road, bridge and tunnel, and urban transit projects. It is also capable of providing the ratings for cost and time to completion for airport projects. Within the current effort rail project outcomes could not be rated as insufficient data were available for analysis. All port project outcomes as well as airport project traffic and revenue outcomes require an adjustment of the indicator composition in order to represent the market interrelations of these transport infrastructure modes. For these cases the TIRI could also not provide meaningful ratings.

The TIRI and the BENEFIT Matching Framework indicators have been developed based on project information which is **readily available in the public domain** and do not require privileged access or highly detailed information to produce results. In its current formulation, the TIRI is well-positioned to:

- Assist private project sponsors in determining the **nature and extent of their involvement** in the various project phases.

- Assist in **building and testing various ex-ante project scenarios** providing support to:
    - Public Authorities to:
        - Better allocate risks or assess the influence that project structure decisions may have on the project's potential of reaching specific outcome targets under various implementation context conditions. Through this process it may also allow for the identification of adverse factors and the specification of corresponding mitigation and other performance-enhancing actions, including modifications to funding and financing schemes
        - Create improved and supportive project procurement processes.
        - Assess alternative implementation scenarios under (re) negotiations.
    - Private parties to:
        - Consider and evaluate investment options.
        - Investigate and gauge the impact of their involvement on project outcomes.
        - Assess alternative scenarios under (re) negotiations.

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- Assist in **monitoring** project "health" during implementation and operation.

- Assist in estimating **the impact of new financing and funding schemes** on project outcomes due to the TIRI's capability to consider current and potential future funding and financing schemes.

- **Improve the creditworthiness** of a project as it provides information with respect to the ability of a project to mitigate downside impacts through risk management rather than by placing the emphasis on its financing structure. In this context, the TIRI can act complementarily to existing commercial credit ratings as the combination the two ratings (Credit and TIRI) can provide a more comprehensive assessment of project resilience: **Managerial and Financial.**

Notably, the **TIRI guides decisions as to which factors need to be improved or changed** in order to reach desirable project outcomes. In the process, the **TIRI will also indicate which project characteristics cannot be further improved** providing an enhanced understanding of its potential and, also, minimising or eliminating the cost of ineffective actions and interventions. In addition, once again, the importance of the planning stage of the project is highlighted.

4.4.2 Recommendations for Further Development

While the Transport Infrastructure Resilience Indicator and accompanying rating system and methodology is **well-positioned to function as a Decision and Policy Guiding Tool**, it can be **further developed to reach its full potential**. Research conducted within BENEFIT[56] can provide the starting point in order to address limitations and broaden the domain of its application

Sample size and accuracy limitations need to be addressed through the consideration of additional project cases across all modes of transport. The methodology can be strengthened and improved considerably if implemented along the same lines of Credit Rating Agencies (CRA) methodologies, i.e. enjoying full information disclosure from all project stakeholders. Such an increase of information depth and breadth can lead to the reconsideration of the level of granularity of the BENEFIT Matching Framework indicators and, in turn, to a more detailed and reliable modelling of the transport infrastructure delivery system. In this context, key factors that have been introduced in aggregate format, such as innovation, could be addressed in more detail.

In addition, the availability of additional project cases would allow:

- Infrastructure modes and outcomes, that are currently not fully addressed to be included in the TIRI rating methodology
- The Market Efficiency and Acceptability Indicator of the Funding Scheme typology, which was in the current analyses found not significant to be fully assessed.[57] This would allow further assessment of the influence of infrastructure pricing, which in the present final version of the BENEFIT Policy Guiding Tool is only implicitly introduced through the attractiveness of the remuneration scheme and the robustness of the revenue scheme, the indicator deserves further investigation
- Allow a weighting between indicators, which may further simplify the rating methodology

Furthermore, the TIRI methodology and its accuracy can also be substantially improved through a more **extensive application to a larger and more detailed sample of cases**. Such a wider application will not only benefit from the increase of modelling accuracy that will come from the recalibration of the BENEFIT Matching Framework indicators, but will also allow a more quantitative, probabilistic consideration of the likelihood associated with the attainment of the various outcome targets within the various rating categories.

Ultimately, the adoption of this methodology by the industry can lead to the development of time-series data of the attainment of project outcome targets which can vastly improve the prediction capabilities of the

[56] See BENEFIT Deliverables D3.2 and D5.1

[57] The finding might be sample -specific, that is the indicator was not important for any of the cases in the BENEFIT sample of cases but also it might be that influence of the indicator is captured by other indicators, such as the remuneration attractiveness indicators, which includes the risk of the remuneration scheme and, therefore its acceptability; or the Revenue Scheme Robustness, which includes the risk of revenue and, therefore its market efficiency to some extent.

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methodology and further enhance the state-of-the-practice with respect to the assessment of a project to deliver on its expected outcomes.

Finally, the simplicity offered by the current configuration of the BENEFIT Policy Guiding Tool should not be overlooked. In its present formulation, the BENEFIT Policy Guiding Tool is able to handle and **provide results based on information available in the public domain** and, therefore, well positioned to support:

- Decisions concerning ex-ante scenarios of project development, where information by definition is not detailed.
- External stakeholder decisions, for whom information concerning the project is, usually, not fully disclosed.

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5 Policy Guidelines and Recommendations

5.1 General Recommendations and Policy Guidelines

The following recommendations and policy guidelines are put forward based on the lessons learnt and general conclusions of the BENEFIT project presented previously.

5.1.1 Implementation Context

Furthering the development of strong institutions in support of competitiveness

- While governments strive to improve economies and foster growth and development, the global nature of the economy will always remain a risk factor which may adversely influence mobility and infrastructure project delivery and operation. However, further support to national institutions and their improvement apart from other benefits, will also enhance transport infrastructure project resilience.

5.1.2 Project Structure

Promoting viable and mature projects

- A robust and evidence-based raison d'être is indispensable for the successful delivery of any and all transport infrastructure projects. A sound needs assessment and rigorous feasibility and viability analyses ought to inform the selection of projects that are promoted for delivery and implementation. This is a prerequisite in order for rational decisions to be made and any subsequent modelling effort to be able to capture successfully and meaningfully the interdependencies of the various parameters that influence the delivery of transport projects.

- Well-justified projects with well-developed **demand forecasts** are a long standing recommendation. However, it is important that demand forecasts also consider **a wider range of potential growth scenarios** as the last twenty years in Europe we have seen fluctuations in the global competitiveness ranging within ±30%. Also a longer **duration** of such fluctuations should be taken into account as well as the respective willingness to pay.

- The preparation of mature projects has also been a long standing recommendation. Well-prepared, well-justified, and well-planned projects, including life cycle planning, are a pre-requisite for achieving projects delivered within cost and time targets.

- A transport infrastructure project's **network connectivity** is of great importance and should be considered as part of project justification and planning, as it is of equal importance to project exclusivity.

- Whether addressing greenfield or brownfield projects, of any level of complexity or investment size, it is important to diligently develop, lay down and follow **well-defined procedures in project design, justification and planning.** Normally, this refers to an iterative process whereby costs and benefits are assessed until tender, award and financial close are concluded.

- The **combination with other services and integrated (bundled) projects** should be considered and exploited. Emphasis should be placed in developing projects for which a risk portfolio of revenue streams may be created.

- **Innovation** should not be avoided or over-rated. It is important that innovation is carefully selected with respect to its level of maturity and its expected benefits/efficiencies and **implemented by competent contractors** who would take full responsibility of related risks by holding the relevant expertise.

- Finally, emphasis needs to be placed on the front-end of project development (planning, procurement, financial close) in order to provide the necessary tools that will enhance and facilitate managerial

flexibility. Such flexibility should also allow corrective actions to be taken during the life-cycle of the project by aiming to minimise relevant future transaction costs.

Competences and Capabilities

- **Strengthening the competences of the public contracting authority** has been identified as an important measure that can strengthen the performance of projects with respect to achieving their project management goals. In addition, a competent contracting authority will be able to prepare mature projects and well-designed tenders suited to the needs of each project. Special emphasis is required particularly towards improving the competence of local and regional authorities. Notably, apart from the improvement of human resources, competences also include the provision of financial resources needed. It is estimated that local authorities do not only lack appropriate human resources, but also the financial resources to systematically prepare, tender and monitor projects (including data collection).

- Tenders should be designed so as to attract the interest of **competent contractors for the specific project**, who are able to manage and bear the technical risks of the project.

- The **ability to manage, control and influence demand** should be a key consideration when assigning the operation of transport infrastructure projects and should be properly considered in tender preparation.

- Finally, under the current conditions, the **PPP model** of project delivery needs to be based more on the anticipated **benefits due to the competences of the concessionaire rather than the need to contribute to the public budget**.

Responsibility Sharing - Risk allocation

- Risk management is a well-developed field and well-defined risk management practices should be followed.

- Appropriate risk allocation should be applied to both PPPs and public projects on the same basis.

- Appropriate risk allocation, including demand and revenue risk, leads to less costly projects, as risk premiums and potential risk impacts are limited.

In the particular case of demand/revenue risk, risk allocation should take into consideration both the level of control/coopetition (level of exclusivity, the impact of network connectivity on the project's exclusivity and the project's business scope) characterising the project vis-a-vis each party's respective competence.

In general, risk allocation to the private sector is considered "appropriate" when the private party has the competence and the managerial capability to influence the conditions leading to risk.

5.1.3 Governance

- Well-designed tenders, prepared by a competent public contracting authority in a country with supporting institutions are the prerequisites for good governance. Contracts should include terms and conditions which support the **"efficiency/effectiveness of governance" and "contractual flexibility"**[58]. More specifically, the open options for enhanced project governance include the collective estimation of investments, the involvement of many bidders, the integration of design and construction, the allocation of rising cost risk to the contractor, the enforcement of penalties if completion dates are not met, the setting of incentives for performance, the setting for the contracting part the option to terminate the agreement prematurely without cause, and the setting of the flexibility of the contract by clauses that specify updating of service terms and enabling price changes.

[58] The BENEFIT GI indicator is assessed with 25% of its overall value corresponding to flexibility and the rest to "efficiency/effectiveness of governance".

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- With each **renegotiation**, if specific terms are not included in the original contract, the quality of **governance declines**. Public authorities should properly consider this fact.

- In PPPs short contractual periods have proven useful in many cases (see e.g. urban transit projects). **Short contractual periods** allow the public sector to re-adjust policies without undermining governance, especially given new mobility patterns that might emerge due to innovation and changes in other societal sectors. The length, however, of the contractual period, even when shorter, needs to be properly estimated.

5.1.4 Funding and Financing Schemes

- As the performance of a project, in terms of cost and time to completion and the attainment of traffic and revenue forecasts, appears to rely less on the type of financing and more on project characteristics, projects considered to be delivered as PPPs and those considered for public procurement (and financing) should be prepared and matured following the same procedure.

- While evidence was not found on a differing performance between traditional and PPP procurement, it was found that the financing scheme structure creates incentives and **induces trade-offs between cost and time to completion, as well as traffic and revenue targets**. The impact of these trade-offs on transport infrastructure project goals (relief of congestion, reduction of travel time, environmental impact etc.) should be carefully considered, as project benefits and welfare gains might be reduced or lost.

- In addition, given the fact that PPPs are costlier in terms of the employed capital, it is important to define in **purely monetary terms the benefits that will be accrued through PPP procurement**. In this context, respective methodologies of comparison should be reviewed and revised to take into account **the financial contributions required by the public sector**.

- It is important to differentiate remuneration methods from revenue schemes. This would allow for proper and fair user charges in accordance to willingness to pay and the implementation of public tariff and mobility policies. Remuneration schemes also reinforce potential incentive and trade-offs (see above).

5.1.5 Impact of Financial Crisis

The global financial crisis (GFC) has highlighted a number of deficiencies in transport infrastructure delivery and operations. The following recommendations address these issues and also constitute further recommendations with respect to funding and financing schemes.

- **Reducing operational costs** should be viewed through the inclusion of operations technologies and practices that will **improve efficiency**. This also applies to maintenance and respective materials. The recommendation touches upon the issue of innovation, new materials and technologies, which also come with an additional investment cost.

  Financing schemes need to be devised based on existing experience to address the lack of capital, especially for maintenance. New financing schemes should be guided by the principle of low risk. In this context, new actors with the respective competence should be supported to enter the market both as innovation promoters and **project sponsors**.

  - **Research on new financing schemes** is needed. Financing Schemes based on protecting against risk, only lead to a greater cost of capital and greater contributions by the public sector to render projects financially viable. As the key consideration in financing is risk, the search for **new financing schemes** lies in identifying means by which **risk may be minimised.** According to the BENEFIT project findings, the focus should be on:
    - **project characteristics and management**,
    - **mix of competences able to appropriately carry risk** as opposed to measures of risk mitigation which lead to greater risk premiums.

- **New actors**, especially carrying **competences in innovation**, should be encouraged to enter the transport infrastructure delivery and operation market. Notably with a scope of improving the mix of competences involved in project delivery and operation.

- Finally, the cost of capital and, consequently, the cost of the financing scheme has been heavily dependent on the national implementation context. The **BENEFIT** project has put forward a decision policy tool, which would allow for an **improved assessment of a project's potential** to reach specific outcomes and, also, of the impact of built-in managerial flexibility over the life-time of the project under specific implementation conditions. Hence, **as uncertainty is reduced so should the cost of the financing scheme.**

5.1.6 Information Sharing

The information deficit, while often discussed, needs to be properly addressed. National infrastructure registers including relevant information on projects, transport and other, should be kept. Systematic prioritisation of projects and respective needs should be followed. The effort apart from registering experience that may be exploited in the future may also limit optimism bias, usually generated by the need to carry out a project in priority.

The above recommendations, with the necessary modifications where appropriate, may also be relevant for other infrastructure sectors.

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5.2 Key Recommendations per Transport Infrastructure Mode

The previous recommendations put forward apply across all transport infrastructure modes. The present section stresses particular issues per mode.

Road Infrastructure Projects
Road infrastructure is the most vulnerable to exogenous adverse impacts. In addition, key characteristics that might improve project resilience (exclusivity, multiple revenues streams etc.) have limited applicability in the case of road infrastructure. In addition, in Europe, the development of road infrastructure in most regions is such that new projects need special consideration as to their value propositions. More specifically:

- New projects addressing missing and cross-border links, while bearing similarities with respect to key project characteristics, need to address special issues of governance, institutional and public authority competence, amongst others.

- New regional road financing should carefully consider potential value-added propositions including the possibility of their inclusion in wider development projects.

- Finally, financing schemes geared towards maintenance and improvement projects (brownfield projects) need to be considered. Including innovation (new technologies, materials etc.) is highly important. The potential of including innovation providers as project sponsors should be investigated.

Bridge and Tunnel Infrastructure Projects
Bridge and tunnel projects are, by nature, technically demanding but also carry the potential of demonstrating performance enhancing characteristics (exclusivity, network conductivity etc.). Hence, apart from the general recommendations with respect to planning, competences etc., their positioning in the network is of great importance as it would allow (or not) projects to take advantage of such performance enhancing characteristics.

Stemming from infrastructure spatial positioning, it is important to note that bridge and tunnel projects connect or facilitate connections with previously “isolated” localities/regions and, in this context, may have a great impact on local and regional development rendering them “politically sensitive”. Wider policy planning and development competences are, therefore, needed when addressing the delivery of bridge and tunnel projects as well as the ability to manage competing local and regional interests.

For cross-border projects, the above-mentioned considerations might also be relevant.

Urban Transit Infrastructure Projects
Urban Transit projects bear advantages and limitations with respect to their delivery and operation. Advantages include the potential of integration with other transport services and development as well as exploiting periods of slower growth to promote modal shift. Limitations concern the political sensitivity associated with the provision of public transportation, which forces local authorities to allow “risk creep” and, in the end, bear greater risks than initially agreed.

Wider planning is, therefore, needed to be included in urban transit project maturity and support to local contracting authorities to be able to properly share risks and limit “risk creep” activities.

Airport Infrastructure Projects
Airport projects face similar challenges as other infrastructure projects with respect to their construction. They may present features allowing them to reach their cost and time targets. The BENEFIT project was able to assess the likelihood of airport projects reaching time and cost to construction completion targets.

It was, however, identified that traffic and revenue targets are influenced both by local/regional/national conditions with respect to economic activity, network connectivity and exclusivity but also by the international context, which is currently not considered by the BENEFIT indicators.

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Port Infrastructure Projects
The BENEFIT Matching Framework was not able to address Port Infrastructure Projects, as it was identified that the BENEFIT Matching Framework indicators need to be adjusted to reflect the particularities of the sector. These concentrated on the competence of the operator to manage the supply chain and the influence international competitiveness and the structure of international supply chains vis-à-vis the port location.

These aspects should be considering during the planning and tendering process.

Rail Infrastructure Projects
The rail sample in the BENEFIT was limited, restricting the ability to properly address the topic and include rail projects in the TIRI rating methodology. However, apart from the general recommendations presented above which apply to all infrastructure modes, the following two aspects should be noted as the key differentiation parameters for rail projects: technically complexity and project justification.

The former requires careful consideration and coherent collaboration between the public and private actors involved in design and delivery. The latter stems from the position of the rail infrastructure in the market and its competition with other transport services and modes. This puts more emphasis on the feasibility study phase and pre-contract planning.

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5.3 Recommendations on the Use of the BENEFIT Matching Framework

Recommendations for effective and efficient project planning and implementation capacities
The BENEFIT Matching Framework through the operational Transport Infrastructure Resilience Indicator (TIRI) rating could be **used through the project life-cycle** to provide assessments of the likelihood of a particular transport infrastructure project to reach cost and time to construction completion, traffic and revenues targets. More specifically:

- In the **planning phase** it will guide project planning and development and provide guidelines as to how to improve the potential of forming a resilient project. **Scenarios** based on varying financial economic conditions may be assessed.
- In **tender preparation** it will support decisions with respect to the minimum contractual requirements to secure good governance. Notably the calculation of the **Governance indicator would provide a measure of governance quality**.
- At **project award**, it will allow for the assessment of project resilience with respect to its pre-specified outcomes based on the results of the tender procedure. A key **measure of contracting the proper competences** and appropriate risk allocation is the **Cost Saving Indicator**.
- At **financial close**, it will provide the indication of the appropriate mix of public and private funds that would support the achievement of desired outcomes.
- During **implementation**, by adjusting the policy indicators it could support the achievement of particular outcomes and/or provide an estimation of their potential, and, finally,
- During **(re) negotiations**, it could provide a measure of the ability of suggested measures to improve on outcomes and enhance project robustness.

Wider value propositions for the transport infrastructure business model and Synergies Across Sectors
The BENEFIT Matching Framework includes the assessment of wider value propositions and synergies across sectors. While it recognises the limitations of each infrastructure mode to include other value-adding activities, it is constructed to consider value propositions that may lead to alternative revenue streams including green and brownfield sections, other transport modes, other non-transport infrastructure, and purely business endeavours also associated with the exclusivity of the offering and its integration in the wider system it represents. Calculating the **Revenue Support Indicator provides a measure of how inclusive and integrated an infrastructure project** might be; the level of opportunity that may still be exploited and the impact on the likelihood of reaching specific outcomes such a configuration under the particular conditions of a project may have.

Propositions for funding and financing schemes
The study and research conducted within BENEFIT led to the conclusion that appropriate low-cost financing schemes are needed. The Financing Scheme Indicator (FSI) has the possibility to represent any financing scheme, while the same applies for the Remuneration Attractiveness (RAI) and the Revenue Robustness (RRI) Indicators for the remuneration and revenue scheme respectively. This allows project owners and sponsors to assess the contribution of the proposed scheme in achieving project outcomes.

Recommendations for Innovation
The application of innovation is considered in the BENEFIT Matching Framework. However, its successful application is connected to the competence to implement innovation. In addition, innovation carries more risk than is acceptable in many cases. It is therefore recommended that respective competence is included in the project when innovation is considered. Considering innovation sponsors in the financing scheme would also potentially reduce the cost of capital.

Recommendations to increase project creditworthiness
The TIRI rating (static and dynamic) apart from assessing the likelihood of reaching specific outcomes, which supports and contributes in assessing more accurately a project's **creditworthiness**, also allows for:

- Assessing the **managerial flexibility** through the project lifecycle, and, therefore, it is not limited to the assessment of the risk bearing capability of the involved parties.

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- **Guiding improvements**, especially with respect to the policy indicators that may drive specific outcomes
- The effective use of **real options**, although this is not explicitly treated in any of the BENEFIT project cases.

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Annex 1. Summary of BENEFIT Project Findings

This chapter summarises the main conclusions derived from the ex-post analysis and assessment of the actual cases included in the collective BENEFIT database. It includes the tasks addressing "lessons learned", "limitations of funding schemes and recommendations" and "the effect of the economic and financial crisis" as well as findings reached through the construction and validation of the BENEFIT Matching Framework Indicators. For each analysis conducted the sample and methodology applied is stated.

A.1.1 Descriptive Analysis[59]

Sample Analysed:	All Case Studies
Analysis Method:	Descriptive Statistics, Cross-tabulations of influencing and outcome variables

Key findings:

- PPPs seemed to meet more the investment cost targets than public financed projects.
- PPPs are more inclined to overestimate forecasts at a higher rate, compared to the public financed ones. This result might be potentially explained by the higher charges levied to the users to achieve cost-coverage.
- Projects featuring a low level of complexity could be more likely to show outcomes that materialise according to forecasts. This did not apply to size of the investment. Complexity was analysed through different influencing variables, including type of development (greenfield; brownfield or mixed), physical description (node and link) and the size of the investment (in ranges per value of the investment)[60].
- User-specific projects (such as dedicated railway lines, freight terminal, etc.) are more likely to perform better than those conceived for mix use (i.e. motorways, non-dedicated railways, etc.).
- Projects seem to perform better when boundaries are well delineated on spatial, technical (in relation to complexity) and modal (in terms of specialisation) aspects.
- Projects depending only on user charges perform generally better with respect to cost-to-completion. One could infer that projects with user charges may have an incentive to keep costs and implementation schedule more under control (e.g., to avoid the so-called "debt trap"). Demand forecasts are less accurate, although particularly important for projects relying on user charges.

59 See Deliverable D4.1

60 The distribution of the outcomes suggested that brownfield cases were more inclined to meet initial costs and demand forecasts. This could be explained by the availability of historical data on construction costs and traffic. The analysis on the physical description suggested that cases within nodes and links are less susceptible to cost overruns and delays and more consistent with demand forecasts (in this case a significant difference did not emerge amongst financing schemes). Instead, the case studies examined seemed not to confirm the hypothesis that small projects are less likely to exceed cost forecasts, with respect to larger ones.

A.1.2 Indicator Validation Findings[61]

A.1.2.1 Implementation Context Typology: Financial Economic (FEI) & Institutional (InI) Indicators

Sample Analysed:	Country International Indicators & Indices
Analysis Method:	Cluster Analysis; Correlation Analysis

- The Financial Economic Indicator uses values of the 'growth competitiveness index', as developed and validated by the World Economic Forum.
- Institutional Indicator was validated using cluster analysis with the dimensions of institutional context. Additionally, correlation analyses, studying the correlations between the institutional Indicators and the scores on the different dimensions, on the one hand, and studying the correlations between the dimensions, on the other hand showed the robustness of the institutional Indicator and the extent to which it adequately represents the underlying dimensions[62].

A.1.2.2 Transport Mode Context Typology: Reliability – Availability Indicator (IRA)

Sample Analysed:	All Cases
Analysis Method:	Fuzzy set Qualitative Comparative Analysis

The transport mode typology is structured based on three main dimensions: 1) Investments, 2) Users and 3) Market strength/competitiveness including in total 35 key indicators (total investments/costs; contract duration[63]; reliability; availability; maintainability; safety and security; risks born directly by stakeholders (regulatory, financial, revenue, design, construction, maintenance, exploitation and force majeure); risk allocation, assessment and mitigation; location (type of connection and node/link); level of integration and level of exclusivity of the project). Some indicators included in other typologies were excluded[64].

The analysis was run for three samples: 1) only PPP cases (34 cases), 2) only public cases (19 cases) and 3) combined PPP and public cases (53 cases). These cases are also selected based on the availability of their data.

- Results of the three analyses showed that the same combination of conditions **"reliability and availability"** affect the success of transport infrastructures. An aggregated indicator combining these two indicators is created: $I_{RA} = (1+I_R) * (1+I_A) / 4$ $I_{RA} = (1+I_R) * (1+I_A) / 4$.
- IRA sub indicators can take discrete values (0, 0.5, 1) and not continuous values from 0 to 1[65]. Thus when assessing the reliability and availability of a transport infrastructure, someone can only say that 1) reliability was improved fully in line with expectations or even more (value 1), 2) reliability was improved partially in line with expectations (value 0.5) and 3) reliability was not improved or only marginally improved (value 0) (similarly for the 'availability').

[61] See BENEFIT Deliverables D2.2; D2.3; D2.4; D3.1; D4.2 and D4.4

[62] *Note:* the dimension on regulatory restrictiveness (OECD ECTR scores) is for specific years (e.g. see 2013) less strong correlated with the other dimensions and with the overall index. However, the cluster analysis showed that the distorting effect of this is small. In conclusion, the Institutional Indicator can be used as a good representation of the underlying dimensions.

[63] *"Contract Duration is also an important indicator of the Transport Mode context typology because it has a direct impact on funding. The longer the PPP contract, the higher the collected revenues will be as captured by the project's Funding scheme. Contract Duration is also important for PPP projects because of the uncertainty associated with the usual long time horizons that characterize such projects. Long term contracts bear bigger risks because they are then more politically sensitive and these could have an impact on the financing of the transport infrastructure project (European Bank of Reconstruction and Development, 2015). Infrastructure investments also have ups and downs, depending on the economic cycles (European Bank of Reconstruction and Development, 2015). For the above reasons, the Contract Duration indicator is also a critical indicator for the Transport Mode context typology (Moschouli and Vanelslander, 2016)".*

[64] For the full list of factors overlapping with other indicators/typologies see D2.2. For the full list of factors tested see D3.1

[65] Governance indicator also is calculated based on sub indicators which take discrete values.

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A.1.2.3 Governance Typology: Governance Indicator (GI)

Sample Analysed:	All Cases
Analysis Method:	Importance Analysis; Statistical Analysis

Identified through literature review and validated through statistical analysis and importance analysis on the entire sample the following factors were found as:

- Pareto improving amendments, considered as renegotiations that improve the welfare of one party without worsening the other, usually leading to a reduction of transaction costs and limiting contractor opportunistic rent seeking:
  - Clauses enable updating of service and/or price changes
  - Clauses indicate that client has an option to terminate the agreement without cause
- Supporting the reduction of transaction costs:
  - Encouragement of competition between bidders
  - Integration of design and construction
  - Bonding requirements
  - Commercial/revenue & financial risks are not concentrated
- Formal mechanisms of project governance associated positively with project performance:
  - The client selected only one service provider [bidder] to participate in the pricing stage
  - The client and the key service providers [bidders] collectively estimated the expected project cost
  - The key service providers [contractor] to pay a penalty if completion dates were not met
  - The key service providers [contractor] solely carried the risk of rising costs

A.1.2.4 Funding Scheme Typology: Remuneration Scheme Attractiveness (RAI), Revenue Robustness (RRI) and Market Efficiency & Acceptability (MEAI) Indicators[66]

Sample Analysed:	All Cases
Analysis Method:	Descriptive Statistics; Hypotheses Testing

Findings

- *Strong positive relation between RAI and traffic*

A high RAI is associated with remuneration schemes based on public subventions rather than collection of user pricing revenues – where user pricing revenues are independent from remuneration – would give an additional pricing flexibility which would allow a better management of traffic and revenues. This hypothesis is difficult to validate, and considering the qualitative information available about pricing policy across cases, it is not evident that it would be a critical factor to this relation.

- *Weak negative relation between RAI and time targets*

A possible exogenous factor causing this negative correlation is the type of financing (private, public). PPP projects have lower RAI scores on average. At the same time, PPP project commonly face stricter, contractually set, conditions on the completion of the project as a whole, leading to a higher compliance with time targets.

- No significant relation was found with the MEAI indicator.

[66] Also see BENEFIT Deliverable D4.1

A.1.2.5 Business Model Typology: Cost Saving (CSI) and Revenue Support (RSI) Indicators

Sample Analysed:	All Cases
Analysis Method:	In-depth qualitative analysis; Hypotheses Testing; Descriptive Statistics (Spearman's non-parametric tests); Principal Components Analysis; Importance Analysis

The factors composing the CSI and RSI were analysed and validated independently and in combination in order to generate the appropriate indicator configuration.

Project Characteristics

- Reaching time and cost targets is not dependent on the investment size.
- No statistical correlation was found between the ability to reach cost and time targets and user-mix.
- No statistical correlation was found between the ability to reach cost and time targets and project position in the transport network (node – link).
- The incorporation of a brownfield section was not found to be statistically correlated with reaching traffic targets.
- Brownfield sections included in the project often lead to optimism bias with respect to traffic forecasts.
- Brownfield projects are often able to reach time to completion targets.
- Projects with bundled activities demonstrate lesser performance with respect to cost and time to completion probably due to the increased complexity and stakeholder involvement.
- Projects with bundled activities are to a lesser extent influenced by the crisis.
- Projects with greater level of coopetition/control are more resilient to the crisis.
- Contracting authorities typically place emphasis on creating exclusivity terms for the project (especially in the case of PPPs), transferring more risk than justifiable to the private sector, ignoring though the impact of network integration, such as missing connections, or other mitigation measures that could potentially surpass the project's exclusivity regarding the level of control.

Traffic and Demand Risk Allocation

- Appropriate risk allocation allows projects (both PPP and Public) to perform better (validated in the present sample).
- In PPPs, contracting authorities systematically pass over to the private sector more demand risk than may be controlled, increasing the project's vulnerability to macroeconomic changes, as well as incurring additional risk premium and/or mitigation costs to the public sector.
- Revenue support or other mitigation measures are put in place to:
    - Reduce risk exposure.
    - Accompany restrictions in pricing (or prices are set and/or approved by the public authority), as these actions further reduce the private sector's control over risk.
- Misallocation of demand risk often lead to renegotiations.
- In public delivered infrastructure, most traffic demand risk is appropriately retained by the central state.
- Passing traffic demand risk over to the operator/concessionaire tends to also create expectations of larger traffic volumes. However, the general tendency observed was the employment of conservative traffic estimates in PPPs.
- Optimism bias was noted in certain cases. The analysis identified a considerable number of cases where projects did not perform in line with expectations of traffic demand regardless of the effect of the macroeconomic conditions.
- Demand forecasts have been observed to be more accurate in conditions of equitable risk allocation.
- The analysis also identified a number of cases delivered by the public sector, as cases that could have been delivered through PPP. This relates to cases whereby the level of control is such, and/or the project is well positioned, that the operator would have been in a strong position to manage the traffic demand risk.

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Remuneration

- In PPPs, while there is a possibility to differentiate the revenue stream from the repayment (remuneration) scheme, this is usually not applied. However, recently, there has been a change witnessed.
- A recurring trend in private-public procurement is the use of user charges (31 over 40 cases studied), while the opposite occurs in projects delivered by the public sector (9 over 23 cases studied).
- Revenue support or no user charges could be justified when macroeconomic conditions are not favourable.

Capabilities

- The capability to operate supports outcomes and is highly correlated to outcomes when bundling of activities exists.
- When traffic demand is allocated to the private sector bearing influence on the supply chain is important but may also be strategically manipulated by concessionaires.
- The frequency of cost and time overrun is greater in publically delivered projects but no correlation was statistically found.
- Capability of the Contracting Authority is positively correlated to project performance (cost and time to completion and traffic targets).

A.1.2.6 Financing Scheme Typology: Financing Scheme Indicator (FSI)

Sample Analysed:	All Cases
Analysis Method:	Descriptive Statistics

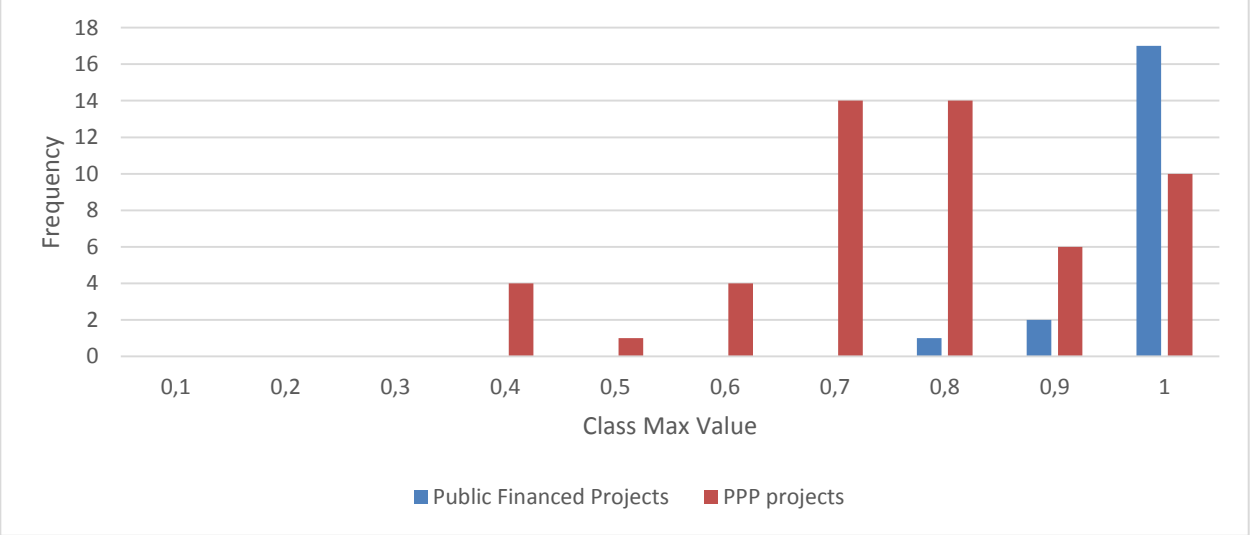

Figure A.1: Histogram of FSI values of the BENEFIT Project Case Database

The BENEFIT Matching Framework addresses PPPs and Public Financed projects uniformly through the Financing Scheme Indicator which is based on an adjusted WACC (weighted average cost of capital) in order to include the cost of public resources. Structured as 1-$WACC_{adj}$, FSI →1 describes projects with a higher contribution of financing from the public sector, with FSI=1 representing a project fully financed by the State. Respectively, FSI →0 indicates projects fully supported by private financing. One would expect PPPs to be FSI<0,5.

However, few projects stated as PPPs demonstrated a FSI <0,5. The majority of cases were geared towards FSI=1 showing heavy support by the public sector.

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A.1.3 Road Projects[67]

Sample Analysed:	All Road Project Case Studies
Analysis Method:	In-depth Qualitative Analysis

General Findings

- The majority of projects that experienced cost and time overrun are located in southern countries.
- PPP road projects are in general better performing regarding cost and time overrun than public ones.
- Brownfield PPP and Greenfield Public road projects are delivered more successfully regarding cost criteria.
- Cost overrun is mainly present on medium sized projects, typically related to scope changes, expropriation and archaeology problems, economic crisis, and in certain cases other technical issues.
- Time performance appears to be more critical for road projects than cost overrun, whereby more delayed are small projects compared to medium and large ones. The most typical reasons for delays in road projects are economic crisis, expropriation problems, design changes, technical and archaeology issues, but also bankruptcy of the contractor.
- Traffic forecast is typically more optimistic for PPP projects.
- Traffic overestimation is more present on medium and large size projects.
- PPP road projects have better traffic performance when delivered as Brownfield projects. No similar observation can be made for public projects.

Impact of Crisis Findings

- Most of projects in countries, in which the crisis impact was low to moderate, are performing well.
- The consequences of global crisis may be most clearly seen in the cluster of countries highly impacted (mostly southern European countries and UK).
- The consequences of the global financial crisis on the poorly performing projects are reflected through:
  - Many projects have to be renegotiated (Portugal, Greece, UK)
  - Reducing the scope of projects /significant reduction of the project size (Greece)
  - An increased government participation (Greece)
  - Introduction and/or increase of user paid tolls (Portugal, Greece)
  - Payment of claims (Greece)
  - Cost underestimations (Serbia)
  - Time overruns (Serbia, Greece)
  - Substantial drop in Annual Average Daily Traffic (AADT) and revenues (Spain, Portugal, Greece)
  - An imbalance of the risks shared between the public and private partner (Greece)
  - Cash flow difficulties as a consequence of public budget restrictions (Spain, Greece, Portugal)
- Critical success factors of projects performing well in crisis impacted countries include:
  - Long term planning
  - Top priority projects
  - Realistic traffic projections
  - Medium size projects
  - Strong regulatory body and governmental support
  - Responsible and well experienced concessionaire
  - Introduction of innovations (Norway, Poland, UK)

Extended case database (proprietary database included)

New PPP deals in Europe since 2008 show:

- The dominate funding scheme has shifted from demand based to availability based.
- New countries with high institutional development and positive macro-economic projections have entered the market.
- Countries typically present have reduced their participation or even exited the market. The observation questions the initial raison d' être of the financing scheme for road infrastructure.

[67] See BENEFIT Deliverables D4.2 and D4.4

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A.1.4 Urban Transit[68]

Sample Analysed:	All Urban Transit Project Case Studies
Analysis Method:	In-depth Qualitative Analysis

General Findings

- Urban transport projects with low initial budget typically experienced significant cost overrun.
- Cost difficulties during their construction phases are usually due to lack of project maturity rather than inherent in their business models. Reasons for delays in urban transport projects are: failure of private contractors, difficulties encountered during land acquisition procedures, technical difficulties and additional work/insufficient project planning.
- Ridership is usually overestimated, leading to lower cost coverage ratios and, consequently financial difficulties for the operator.
- The transfer of design/construction risk to the private sector does not necessarily mean that deadlines will be respected or costs complied with. Risk allocation seems to play a minor role in the success or failure of the operating phase, since urban public transport projects are mainly locally driven projects with a high involvement of elected local politicians. Consequently, these projects show high political sensitivity and their risk sharing has to be assessed in this perspective. In practice, the public authority accepts to bear a part of commercial risk bigger than planned in order to ensure that the public transport projects (or public transport networks) will be run as expected.
- Contract duration seems to be one of the major success factors for the project in its operating phase. When operation is transferred to the private sector for a long period of time, projects systematically encounter difficulties visible through contract renegotiations or breaches of contract.

Impact of Crisis Findings

The impact of crisis on Urban Transport projects is even more difficult to assess, since it should be analyzed on the network level, particularly in the operational phase, and most probably the impact has been larger on peripheral, supporting networks, compared to central lines.

The crisis had underlined the capacity of cities and countries to support urban transport policies and projects and the importance of proper planning and design of sustainable urban transport networks taking into account realistic demand.

- Slowdown in ridership in many countries, but did not reverse the general trends of increasing ridership in urban transport since 2000.
    - In France, Germany, and Italy, there were almost no negative trends in the increase of ridership.
    - In countries severely hit by crisis, like Spain and Portugal, and Central and Eastern European countries the decrease was substantial as a result of the worsened economic situation.
- Reduced ridership had an impact on secondary revenues, such as advertising, have also dropped.
- Reduced public budgets reduced grants to the urban transit system.
- Increase in operating costs due to higher cost of materials and taxes etc.
- Operators of urban transport network tried to reduce operating costs, either through reducing wages and maintenance costs, or through reducing service offer.
- The financial crisis has also increased pressure on the level of investment to extend or renew metro systems.
- The global financial crisis seems to have relatively small impact on financing of urban transport projects, except in countries hardly hit by crisis, where it exposed structural weaknesses.
- After the crisis, private partners are more reluctant to invest in urban transport systems.

[68] See BENEFIT Deliverables D4.2 and D4.4

A.1.5 Bridge & Tunnel Project[69]

Sample Analysed:	All Bridge & Tunnel Project Case Studies
Analysis Method:	In-depth Qualitative Analysis

General Findings

Bridges and tunnels are most commonly used to overcome natural barriers with the alternatives being usually much longer connections or necessitating the changing of means of transport (road to ferry, etc.). This natural monopoly favours the PPP model for project delivery.

- Both the size of the projects and their vast associated cost result in long to very long preparation periods (ranging from 17 to even 100 years). Notably, designing and constructing special structures requires good preparation. Moreover, the political sensitivity of such projects has a huge repercussion on timing. Change of plans regarding sources of financing, unrealistic expectations for market competition, etc. often result in delays in project implementation.
- Tunnels and bridges as superstructures are cost intensive. The private party optimised costs through changes in technology and/or in design (optimise and build). Such diligence budgeting is not typically found in public cases.
- PPP delivery-based bridges and tunnels are planned prudently in terms of construction costs and realistically in terms of deadlines of construction and implemented according to schedule. Furthermore, in PPP projects regarding bridges and tunnels, traffic estimates were prepared conservatively– actual traffic was greater than expected.
- Projects implemented at the local level proved to be not successful (Herrentunnel, Blanka Tunnel Complex) and had underestimated costs (often grossly, as with the Blanka Tunnel – more than 100%).

Impact of Crisis Findings

- The well-planned and justified projects appear to be more robust in the context of outcomes, despite the difficulties arising from the global financial crisis.
- The exclusivity and protection from competition leads to the possibility of ensuring adequate traffic and thus revenues, despite the cost to the user, due to benefits in time savings.
- Governmental/national level, for both public and private cases is required. Locally driven projects performed less.
- For the project that was completed after the crisis (Blanka Tunnel Complex), the issues in the construction phase were mainly related to the traditional project management issues and planning, and not to the crisis.
- Lack of access to new capital and consequently the implementation of new projects.
- Companies engaged PPP bridge and tunnel projects were very significantly affected by the crisis demonstrated through reduced value of company share prices (e.g. the fall of Macquarie Infrastructure Corporation - the main shareholders in Lusoponte Bridge - 40 USD to 0.79 USD). This had a severe impact of respective projects.

[69] See BENEFIT Deliverables D4.2 and D4.4

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A.1.6 Airport Projects[70]

Sample Analysed:	All Airport Project Case Studies
Analysis Method:	In-depth Qualitative Analysis

The small sample of airport projects included in the BENEFIT database limits the explanatory power of the analysis, as well as the ability to generalise conclusions.

General Findings

- Construction failures are one of the reasons pointed out for cost overrun and delays. Other reasons include uncertainties over additional funding sources, additional funding authorizations and award value.
- Success and failures regarding traffic forecast are associated to economic integration and exclusivity.
- Traffic is influenced by the implementation context but also by the way the airport is connected to the local/regional or national economy. Incentives connected to demand risk allocation are also important.

Impact of Crisis Findings

- Small airports were hit by the crisis with delay compared to large airports.
- Smaller-sized airports have an abrupt fall in traffic growth rate when the crisis hits, whereas larger airports typically keep a relatively stable traffic growth rate (although sometimes negative) throughout the crisis years.
- Some airports like Sa Carneiro in Portugal were able to keep traffic growth, although the growth rate has been substantially lower in 2009.
- Factors that improved the resilience of airport cases:
- the growth in tourism.
- the growth of low-cost airline traffic.
- introducing offering promotions and incentives, enforcing cost controls and other such measures.
- good intermodal connections.

[70] See BENEFIT Deliverables D4.2 and D4.4

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A.1.7 Ports[71]

Sample Analysed:	All Port Project Case Studies
Analysis Method:	In-depth Qualitative Analysis

Impact of Crisis

All six BENEFIT port cases are located in southern European countries, hardly hit by the crisis: Portugal, Spain and Greece. However, all of them, except the port of Sines in Portugal, showed positive overall performance despite the crisis.

The major factors that contributed to the success of these projects are:

- Good planning and appropriate project justification,
- Commitment and financial capability of concessionaires
- Link to major shipping line that allowed the traffic growth even in the case of adverse economic conditions. For instance, the dominant position of Piraeus in the Greek and Mediterranean container market played an important role in the success of the project, as well as the importance of market share of Cosco Pacific, the awarded company. On the other hand, the port of Sines did not have such a dominant position in the container markets, while at the same time faced the strong competition of two competing transshipment hubs – Algeciras and Tanger Med – which have been able to capture the economies of scale that are absent at Sines.
- For passenger Ports: the growth in tourism.

A.1.8 Rail[72]

Sample Analysed:	All Rail Project Case Studies
Analysis Method:	In-depth Qualitative Analysis

The railway project total sample was relatively limited in BENEFIT (8 projects) and in particular the number of PPP cases (one out of the total eight) provided little ground for thorough assessment. The nature of projects varied from station infrastructures to dedicated airport links including infrastructures and exclusive rights to operate the rail services.

Findings

- Most projects experienced delays.
- Railway projects are technically demanding and sub-system interoperability and implementation coordination seem to be constant challenges in such projects.
- The nature of projects' difficulty or under-performance – and these were not many – seem to result more from typical factors such as technical designs rather than factors originating from procurement technique, be it PPP or traditional budget funding.
- In most respects, however, the projects seemed to have achieved their objectives.
- Only one of the sample projects experiences below than forecasted traffic volumes, whilst many of the projects exceeded initial traffic projections.

[71] See BENEFIT Deliverables D4.2 and D4.4

[72] See BENEFIT Deliverables D4.2 and D4.4

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A.1.9 Critical Limitations[73]

Sample Analysed:	Selected Case Studies
Analysis Method:	Cause and effect dynamic systems mapping

Critical limitations refer to the tolerance in "mismatching" (e.g. using a financial scheme which is not justified by the funding scheme), limit of acceptable changes in the implementation context, ability of the contractual arrangement to absorb changes, the resilience of the business model with respect to basic assumptions, etc. To this end, the analysis addressed changes to the typological setting following a system dynamics approach and developing causal loop diagrams. From this analysis of limitations, their frequency, level of criticality and their possible impacts, resilient factors, as well as the outcomes from the renegotiation process, and their causal links, the main critical limitations that hinder the success of Transport Infrastructure Projects were identified. These are listed in Table A.1.1 together with the indicators these relate to. The critical limitations need to be prioritised and addressed if any negative outcomes or failures of projects are to be avoided in the future.

Table A.1.1: Main Critical Limitations

Rank	Limitations	Indicator the limitation relates to	Exogenous/ Endogenous Factor
1	Low macroeconomic dynamism (growth)	Financial Economic	Exogenous
2	Deviation in demand forecast and economic projections	Revenue Robustness	Endogenous
3	Poor risk sharing and management	Governance	Endogenous
4	Low capacity to generate revenues	Revenue Support	Endogenous
5	Low economic-financial feasibility of the project	Financial Economic and Input decisions	Endogenous
6	Lack of user payment acceptance	Market Efficiency & Acceptability	Endogenous
7	Public budget restrictions	Financial Economic Indicator	Exogenous
8	Financial liquidity constraints	Financial Economic Indicator	Exogenous
9	Political instability	Institutional	Exogenous
10	Lack of (re)negotiation capabilities	Cost Saving	Endogenous
11	Changes in user demand and preference	Revenue Support	Exogenous
12	Public debt counting	Financial Economic Indicator	Exogenous
13	High level of technical risks	Cost Saving	Endogenous

Notably of the 13 top ranked limitations identified six are exogenous and 7 endogenous to the project, the latter allowing management interventions. It is also worth observing that, apart from the macro-economic conditions, the next five top ranking limitations are endogenous to the project and may be addressed through management.

[73] See BENEFIT Deliverable D4.3

A.1.10 Fuzzy Set Qualitative Comparative Analysis[74]

Sample Analysed:	All cases described by indicators
Sub-samples Analysed:	Whole Sample (51 cases) PPP Sample (35 cases) Road Sample (22 cases) Completion of Construction before the Crisis - 2008 year-mark (22) Completion of Construction after the Crisis - 2008 year-mark (25 cases for cost and time to completion and 21 cases for actual vs forecast traffic and revenues)
Analysis Method:	Fuzzy set Qualitative Comparative Analysis
Remarks	Indicators IRA and RSI were not included in the analysis as the variation of the respective indicators was not sufficient for fsQCA to be applied.

A.1.10.1 General Findings

Factors affecting Cost to Completion

- The following combination of factors explains 30% of the projects being on cost:
  - The high ability to save costs in the project, thanks to a high capability to construct, to innovate, to allocate the construction risk optimally
  - A good institutional context of the country where the project is located, meaning good regulatory framework, political support and policies and government effectiveness;
  - A high ability to cover their costs by the revenues generated by or for the projects,
  - The political attractiveness of the project funding scheme from the perspectives of the efficiency of utilization of the transport infrastructure (allocative efficiency) and the acceptability of the funding scheme for voters, combined with
  - A contract with good contractual arrangements *and*
  - Projects that are heavily subsidised by the public sector seem to have more chances to be on cost in the above combination.
- A minor share of projects (29%) being over cost are explained by the following combination of factors:
  - Mainly privately financed,
  - Located in a country with unfavourable financial characteristics, like high unemployment rate, inflation, low GDP per capita or low growth competitiveness index *and*
  - Unfavourable contractual arrangements
- Almost two thirds of the PPP projects that are on cost are explained by the combination of:
  - A good institutional context of the country where the project is located *and*
  - A high ability to save costs thanks to a high capability to construct, to innovate, to allocate the construction risk optimally
- One third of the PPP projects being over cost are explained by the combination:
  - Mainly privately financed,
  - Located in a country with unfavourable institutional and financial characteristics,
  - Low ability to save costs *and*
  - Low attractiveness of the remuneration scheme for the investors**.**
- More than two thirds of the road projects on cost are explained by the combination of:
  - Being heavily subsidized by the public sector,
  - A good institutional context of the country they are located in and
  - A good contract.
- One third of the road projects that are over cost are explained by being mainly privately financed.

[74] See BENEFIT Deliverable D4.2, D4.4 and D3.2

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Factors affecting Time to Completion

- Almost half of the PPP projects that are on time are explained by the combination of:
  - The good financial context of a country *and*
  - the high capability to construct, capability to innovate and to optimally allocate the construction risks
- No results were found for road projects and the overall sample for being on-time.
- Almost half of the projects being delayed are explained by:
  - A poor contractual agreement (that probably does not include a clause of a potential penalty that will be imposed in the case that the project will be delayed) *and*
  - Low risk remuneration scheme with high cost coverage (such as availability based schemes)
- 48% of the PPP projects delayed are explained by the combination of:
  - a poor institutional context *and*
  - low ability to save costs.
- Delays to the road projects (51% of road projects) are potentially due to the combination of
  - Poor contractual agreement
  - Poor Institutional setting *and*
  - Acceptability issues with respect to the funding scheme

Factors affecting the Potential of reaching Traffic Forecast

- 52% of the projects reached traffic forecast are explained by:
  - A high capability to save costs *and*
  - Low risk and high cost coverage remuneration scheme
- 47% of the projects that were below forecast traffic were with unfavourable conditions (institutional & a non-attractive to the investors remuneration scheme), despite a good contractual agreement
- 46% of the PPP projects being on traffic are explained by:
  - A high ability to save costs
  - Low ability and risk to cover the project costs from the revenues generated by or for the project, and
  - remuneration scheme which covers a big share of the project's costs
- Almost half of the PPP projects that are below traffic could be explained by either
  - Non robust revenue streams combined with a low capability to save costs ***or***
  - Poor institutional context and non-conducive financial economic context
- Half the road projects that are on traffic were:
  - Located in a positive financial and economic context *with*
  - A favouring institutional context
  - Good contractual arrangements *and*
  - Heavily subsidised by the public sector
- 55% of the road projects below the forecast traffic are explained by
  - poor financial and economic context of the country they are located and
  - a high risk remuneration scheme which covers a small share of the project's costs.

Factors affecting the Potential of reaching Revenue Forecasts

- Almost one fifth of the projects reaching forecast revenues have:
  - A good contract,
  - A high ability to cover the project costs through the revenues generated by or for the project,
  - Are located in countries with good institutional context *and*
  - Are mainly privately financed
- 57% of the PPP projects reaching forecast revenues are explained by:
  - A good institutional context *and*
  - Robust revenue streams (low risk and high cost coverage)
- 66% of the road projects reaching forecast revenues are explained by robust revenue streams
- Almost half the road projects that did not reach the revenue target had:
  - Non-robust revenue streams *and*
  - Poor contractual arrangements

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- No results are found for the entire sample and the PPP sample for not reaching the revenue forecast.

A.1.10.2 Impact of Crisis Findings

Factors affecting Cost to Completion

Completion before the Crisis

- Projects located in a country with a good institutional context can be on cost, even if the financial and economic conditions of the country are not prospering had the potential to reach cost-to-completion
- Almost half of the projects that were over cost were:
    - Financed by the private sector *and*
    - Had less attractive remuneration scheme

Completion after the Crisis

- On Cost were projects located in countries with good macro-economic figures and good growth competitiveness index in combination with a good institutional context, hence in countries least effected by the crisis
- Over Cost are mostly publicly financed projects when dealing with an unfavourable institutional and a not very attractive remuneration scheme

Factors affecting Time to Completion

Completion before the Crisis

- On time were mostly publicly financed projects with good contractual arrangements **or** projects with good contractual arrangements which are supported by a good institutional context and a favourable financial economic context.
- No results are found for the projects delivered with a delay.

Completion after the Crisis

- A non-favouring institutional context strongly affects the ability of the projects to be completed on time
- Half of the delayed projects that did not have good contractual arrangements did not achieve time targets
- No results are found for the projects delivered on time.

Factors affecting the Potential of reaching Traffic Forecasts

Completion before the Crisis

- Actual traffic is below the forecast traffic for almost half of the projects, when:
    - Poor Institutional context
    - Poor financial-economic conditions *and*
    - High risk remuneration scheme
- No results are found for the projects with actual traffic equal or higher than the forecast traffic.

Completion after the Crisis

- Approximately two thirds of the projects on traffic are explained by:
    - A good institutional context,
    - Low risk and high cost recovery remuneration schemes *and*
    - Good contractual arrangements.
- A significant share of the projects being below traffic, are
    - Heavily subsidised by the public sector,
    - In unfavourable institutional context *and*
    - High risk remuneration schemes

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Factors affecting the Potential of reaching Revenue Forecasts

Completion before the Crisis

- Most projects with low risk and high cost coverage revenue schemes reached revenue targets
- No results are found for the projects that did not reach the revenue target.

Completion after the Crisis

- More than two thirds of the projects reaching revenue targets are explained by:
    - A good institutional context *and*
    - A good contract.
- No results are found for the projects that did not reach the revenue target.

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A.1.11 Importance Analysis[75]

Sample Analysed:	All cases described by indicators
Sub-samples Analysed:	Whole Sample (51 cases) PPP Sample (35 cases) Road Sample (22 cases) Completion of Construction before the Crisis (2008 year-mark) Completion of Construction after the Crisis (2008 year-mark)
Analysis Method:	Importance Analysis
Remarks	The factor "level of control" was analysed in place of the Revenue Support Indicator.

A.1.11.1 General Findings

General

Factors affecting Cost to Completion[76]

1. Exclusive position in the network, network favouring the position of the project and business development orientation
2. The institutional context of the country where the project is located
3. Contractual governance
4. The ability to save costs in the project, thanks to a high capability to construct, to innovate, to allocate the construction risk optimally

Factors affecting Time to Completion

1. Contractual governance
2. The remuneration scheme
3. Exclusive position in the network, network favouring the position of the project and business development orientation

Factors affecting Revenue Targets

1. The remuneration scheme

PPP Sample findings

Factors affecting Cost to Completion

1. The institutional context of the country where the project is located
2. Exclusive position in the network, network favouring the position of the project and business development orientation
3. Contractual governance
4. The ability to save costs in the project, thanks to a high capability to construct, to innovate, to allocate the construction risk optimally

Factors affecting Time to Completion

1. Contractual governance
2. Institutional setting
3. The remuneration scheme
4. Exclusive position in the network, network favouring the position of the project and business development orientation

Factors affecting Revenue Targets

1. The remuneration scheme

[75] See BENEFIT Deliverable D4.2, D4.4 and D3.2

[76] Numbering corresponding to rank of importance

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Road Sample Findings

Factors affecting Cost to Completion
1. The institutional context of the country where the project is located
2. Contractual governance
3. The ability to save costs in the project, thanks to a high capability to construct, to innovate, to allocate the construction risk optimally
4. Exclusive position in the network, network favouring the position of the project and business development orientation

Factors affecting Time to Completion
1. Contractual governance
2. The institutional context of the country where the project is located
3. The remuneration scheme
4. Exclusive position in the network, network favouring the position of the project and business development orientation

A.1.11.2 Impact of Crisis Findings

Factors affecting Cost to Completion

Completion before the Crisis
1. The institutional context of the country where the project is located
2. Contractual governance
3. Exclusive position in the network, network favouring the position of the project and business development orientation
4. The ability to save costs in the project, thanks to a high capability to construct, to innovate, to allocate the construction risk optimally

Completion after the Crisis
1. The institutional context of the country where the project is located
2. Exclusive position in the network, network favouring the position of the project and business development orientation
3. Contractual governance
4. The ability to save costs in the project, thanks to a high capability to construct, to innovate, to allocate the construction risk optimally

Factors affecting Time to Completion

Completion before the Crisis
1. The institutional context of the country where the project is located
2. Contractual governance

Completion after the Crisis
1. Contractual governance
2. The remuneration scheme
3. The institutional context of the country where the project is located
4. Exclusive position in the network, network favouring the position of the project and business development orientation

Factors affecting the Potential of reaching Revenue Forecasts

Before and After the Crisis
1. Exclusive position in the network, network favouring the position of the project and business development orientation
2. The remuneration scheme

A.1.12 Econometric Analysis[77]

Sample Analysed:	All cases described by indicators
Sub-samples Analysed:	Whole Sample (51 cases) Dummy indicators for PPP before and after crisis
Analysis Method:	Bivariate probit models; Logistic cluster regression models
Remark	The Institutional Indicator was not included in the analysis as it was found correlated to the Financial Economic Indicator.

A.1.12.1 General Findings

Factors Influencing Cost to Completion

- The financial economic conditions in the country of application
- The exclusivity of the project and its ability to generate revenues
- The ability of the project for cost saving through construction, operational capabilities and the capability of the contracting authority
- The contractual governance

Factors Influencing Time to Completion

- The financial economic conditions in the country of application
- The contractual governance
- The remuneration scheme
- The reliability / availability of the infrastructure

Factors affecting the Potential of reaching Traffic Forecasts

- The financial economic conditions in the country of application
- The remuneration scheme
- The ability of the project for cost saving through construction, operational capabilities and the capability of the contracting authority
- The reliability / availability of the infrastructure

Factors affecting the Potential of reaching Revenue Forecasts

- The revenue scheme
- The remuneration scheme
- The reliability / availability of the infrastructure

A.1.12.2 Impact of Crisis Findings

The global crisis was found to have a negative impact on projects' time to completion and traffic targets. A significant impact was not identified with respect to cost to completion and revenues.
Factors Influencing Cost to Completion

- The Financial Economic Conditions in the country of application
- The exclusivity of the project and its ability to generate revenues
- The ability of the project for cost saving through construction, operational capabilities and the capability of the contracting authority
- The contractual governance

Factors Influencing Time to Completion

- The Financial Economic Conditions in the country of application
- The contractual governance
- The revenue scheme
- The reliability / availability of the infrastructure

[77] See BENEFIT Deliverable D4.2, D4.4 and D3.2

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Factors affecting the Potential of reaching Traffic Forecasts

- The Financial Economic Conditions in the country of application
- The remuneration scheme
- The ability of the project for cost saving through construction, operational capabilities and the capability of the contracting authority
- The reliability / availability of the infrastructure

Factors affecting the Potential of reaching Revenue Forecasts

- The revenue scheme
- The remuneration scheme
- The reliability / availability of the infrastructure

A.1.12.3 PPPs

PPP projects conducted prior to the economic crisis demonstrated a positive and significant effect with respect to achieving cost and time targets in the “cost and time underrun”, the “time underrun” case and in the “traffic” model-runs. However, PPP projects, in general, have a lower probability of achieving “cost and time underrun”. This finding, however, may be sample specific as the BENEFIT case study database includes a significant share of PPPs during and after the economic crisis – some still in recession – which may distort findings. In addition, Bain (2009) had reported the negative influence of recession on road PPPs with respect to traffic if projects had not reached the ramp-up period. This analysis also identified the negative impact on cost and time to completion. The potential effect on cost and time was also identified by Ortega *et al* (2015). Notably, the general economic context of the country in which the project is conducted (“financial economic context” indicator) was identified to have an effect in practically all the models employed in this analysis.

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A.1.13 Expert Opinion[78]

Sample Analysed:	Selected Case Studies and Case Studies described through Indicators
Analysis Method:	Presentations; Round Tables; World *Café*

A.1.13.1 General Findings

Table A.1.2 presents the significance given by experts of the BENEFIT indicators in achieving the pre-specified project outcomes. Overall, participants' opinions are compatible with BENEFIT findings and their synthesis.

Table A.1.2. BENEFIT indicators significant for Policy Dialogues participants

BENEFIT indicator	Policy Dialogues				
	Cost	Time	Traffic	Revenues	Overall
Implementation Context / Institutional	20%	6%	19%	13%	9%
Implementation Context / Financial-Economic	22%	10%	24%	16%	10%
Transport Mode / Reliability-Availability			22%	26%	8%
Business Model / Cost Saving	27%	26%	0%		4%
Business Model / Revenue Support		15%	0%	26%	10%(1)
Governance	31%	29%	26%		10%
Financing Scheme		0%			6%
Funding / Remuneration Attractiveness		15%	9%		4%
Funding / Market Efficiency, Public Accept.				6%	13%(2)
Funding / Revenue Robustness					
New variable: Political support					16%
New variable: Project size					10%

- variable is significant; *- variable is not significant*

(1) Of which 6% relate specifically to the variable level of control, and 4% relate to revenue support as a general indicator

(2) Of which 8% relate specifically to the public acceptability of the funding scheme, and 5% relate to funding scheme market efficiency and public acceptability as a general indicator

The idea that political support for a project is a major determinant showed up in many table discussions, and was voted most important factor in achieving overall project goals. However, the inclusion of this variable requires a discussion on the signal of its influence. For construction outcomes, it might seem that political support works to promote favourable results. The tie-in between variable and outcome in these cases is that a strong political support can accelerate approval processes, and pushes the public authority for the introduction of incentives to achieve construction completion on time/to cost. However, the effect can be opposite to this: a strong political push for the project might lead to speeding projects through their natural

[78] See BENEFIT Deliverable D5.2.

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development process, and procuring them before they are mature enough, which contributes negatively to cost and time outcomes. For operation-related outcomes, a strong political support for the project seems to work to promote worse results in traffic and revenues, since projects that have a strong political push behind them might survive appraisal processes that would consider them unviable. This means that a strong political support might be a cause of bias in project selection, a bias typically surfacing in overly optimistic demand forecasts.

For operation outcomes, the variable “project size” surfaced as an additional indicator with relation to this political support phenomenon described above of going ahead with “bad projects” for political reasons. Because bad “projects are typically put forward on political grounds, they will be high visibility projects that maximize the political value of their delivery to a politician or a political group. Thus, the tie-in between political support and project size, is that more impressive investments have the potential to achieve higher political value. Size, in this discussion, referred to cost, and architectural impact.

For construction outcomes, the “project size” variable surfaced as a measure of project complexity. More complex projects become project management challenges that cannot always be effectively managed, leading to cost and time overruns for a number of reasons.

According to practitioners’ experiences, PPPs seem to be successful at reducing time and cost overruns by setting incentives correctly for those goals. However, for traffic and revenue goals there was no reference of such “magic formula” of risk sharing, or rather, even experienced public authorities have not been perfectly satisfied with demand risk sharing arrangements. Although there were many references to letting the private sector develop their business by awarding them enough demand risk but also enough entrepreneurial freedom, availability models seem to have been the type of risk sharing agreement in fashion during the financial crisis. Some practitioners actually related this with the quality of the projects, as described above. Projects that do not have enough demand or profitability to make them viable for private consortia can either be socially valuable or not. Those that are socially favourable can make a case for government support through some type of availability payment or shadow toll or subvention. But those that are not should be considered “bad projects” which cannot be profitable and do not bring social value-for-money. When the private sector assesses those projects, they will not accept demand or revenue risks, and they will ask for substantial guarantees. Again, practitioners point to the idea that the public authority’s capacity to correctly select projects is key for achieving project goals.

A.1.13.2 Impact of Crisis Findings

Several general variables were considered important for improving project resilience to economic crisis, namely:

- Flexibility (Contract, Tariff, Charges, Business Models, Labour Agreements)
- Possibility for real options (upgrade or downsize)
- Bankruptcy protection
- Structure of financing small private equity, large debt capital, unstable financial costs
- Bundling with other development elements
- Diversification of demand segments
- Better risk allocation
- Better business strategy
- Network Optimization
- Better exploitation of current infrastructure
- Change in political process
- Market exclusivity
- Alternative technology
- Scope of competencies
- Operator capability

Table A.1.3 presents BENEFIT indicators that were found significant (or not) by experts in improving project resilience to economic crises (cause-effect). The “conclusions” were derived after focusing discussion of particular cases to provide a better problem framework leading to logical and organized thinking. However, this bears a risk, as it can lead to a bias of thinking, and to overlooking some important indicators. For

example, it is unusual that the financing scheme, the remuneration scheme or public acceptability were not considered influential.

Table A.1.3 Indicators contributing to project resilience to economic crises by type of infrastructure.

BENEFIT indicator	Infrastructure types			
	Linear	Unique structures	Urban Transit	Airports
Implementation Context / Institutional				
Implementation Context / Financial-Economic				
Transport Mode / Reliability-Availability (IRA)				
Business Model /Cost saving				
Business Model / Revenue support				
Governance				
Financing Scheme				
Funding / Remuneration attractiveness				
Funding / Market efficiency, public accept.				
Funding / Revenue robustness				

- variable contributes to project resilience to economic crises

- variable does not contribute to project resilience to economic crises

Measuring resilience was considered by participants as a difficult task and more a political than an economic problem. Nevertheless, a number of measures and techniques were put forward by the experts, such as:

- The revenue/expenditure ratio
- Safety coefficient
- Degree of enlarged scope of potential revenue
- Stress test
- Equity share
- Revenue and remuneration indicators
- Tolls modulation, if it is possible
- Network optimization in the planning process
- Taking price inflation into account
- An adequate cost-benefit analysis with scenarios and sensitivity analysis improving design towards situations of economic crisis
- Demand diversification and price/service segmentation

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Annex 2. Indicators Contributing to the Achievement of Project Outcomes – Final Assessment

Table A.2.1: Cost to completion Indicator Combinations Across Modes

Modes Indicators	**Road Infrastructure**	**Urban Transit**	**Bridge & Tunnel**	**Airports**
Financial – Economic Indicator (FEI)	Strong positive or negative influence depending on high or low value	-	High Value important but may be off-set by high values of the other indicators	High Value important
Institutional Indicator (InI)	Pre-requisite	High Value	High Value	High Value
Governance Indicator (GI)	Needed (compensates for low CSI)	High Value	High Value	High Value
Cost Saving Indicator (CSI)	Needed (compensates for low GI)	High Value	High Value	High Value
Revenue Support Indicator (RSI)	Support	High Value	High Value (High LoC[79] Important)	High Value (High LoC Important)
Remuneration Attractiveness Indicator (RAI)				
Revenue Robustness Indicator (RRI)				
Financing Scheme Indicator (FSI)	Driver: High values			
Comments		All indicators above should have high values		

[79] Level of Control/Coopetition

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Table A.2.2: Time to completion Indicator Combinations across Modes

Modes Indicators	Road Infrastructure	Urban Transit	Bridge & Tunnel	Airports
Financial – Economic Indicator (FEI)	Positive or negative influence depending on high or low value (May be off-set by GI and InI)		High Value important but may be off-set by high values of the other indicators	High Value important
Institutional Indicator (InI)	Pre-requisite (Acts in combination with GI)	High Value	High Value	High Value
Governance Indicator (GI)	Pre-requisite (Acts in combination with InI)	High Value (May be combined with CSI)	High Value	High Value
Cost Saving Indicator (CSI)	Needed	High Value (May be Combined with GI)	High Value (High LoC Important)	High Value
Revenue Support Indicator (RSI)		High Value	Low Value (May compensate for RRI)	High Value (High LoC Important)
Remuneration Attractiveness Indicator (RAI)	Driver: Low values		Low Value (May compensate for RAI)	Low Value (May compensate for RRI)
Revenue Robustness Indicator (RRI)	Driver: Low values		Low Value (May compensate for RAI)	Low Value (May compensate for RAI)
Financing Scheme Indicator (FSI)			High Value	High Value

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Table A.2.3: Actual vs Forecast Traffic Indicator Combinations across Modes

Modes Indicators	**Road Infrastructure**	**Urban Transit**	**Bridge & Tunnel**	**Airports**
Financial – Economic Indicator (FEI)	Very strong Positive or negative influence depending on high or low value		High Value important but may be off-set by high values of the other indicators	High Value - Connected to international Financial – Economic conditions
Institutional Indicator (InI)	High value may limit effect of FEI	High Value	High Value (prerequisite for Low RAI)	
Governance Indicator (GI)	High value may limit effect of FEI	High Value (May be combined with CSI)	High Value (prerequisite for Low RAI)	High Value
Cost Saving Indicator (CSI)	High value may limit effect of FEI	High Value (May be Combined with GI)	High Value (prerequisite for Low RAI)	High Value
Revenue Support Indicator (RSI)		High Value (With emphasis on LoC)	High Value (High LoC Important)	High Value (High LoC Important)
Remuneration Attractiveness Indicator (RAI)	High value may limit effect of FEI	Support		
Revenue Robustness Indicator (RRI)				High Value
Financing Scheme Indicator (FSI)		High Value	High Value	

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Table A.2.4: Actual vs Forecast Traffic Indicator Combinations across Modes

Modes Indicators	**Road Infrastructure**	**Urban Transit**	**Bridge & Tunnel**	**Airports**
Financial – Economic Indicator (FEI)		Only with respect to advertisements	High Value important but may be off-set by high values of the other indicators	High Value - Connected to international Financial – Economic conditions
Institutional Indicator (InI)		High Value	High Value (prerequisite for Low RAI)	High Value
Governance Indicator (GI)	Support: High Value	High Value	High Value (prerequisite for Low RAI)	High Value
Cost Saving Indicator (CSI)	Support: High Value	High Value	High Value (prerequisite for Low RAI)	High Value
Revenue Support Indicator (RSI)	Expected for High Value	High Value	High Value (High LoC Important)	High Value (also alternative revenues)
Remuneration Attractiveness Indicator (RAI)	Support: High Value	High Value		
Revenue Robustness Indicator (RRI)	Key Indicator	High Value	High Value	High Value
Financing Scheme Indicator (FSI)	Expected for High Value		High Value	
Comments		At least two of the above indicators should bear a high value.		

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Annex 3. Transport Infrastructure Resilience Rating System per Mode

Road Infrastructure

The following Tables A.3.1 to A.3.4 present the system of Transport Infrastructure Resilience Indicator rating per figure-of-merit (outcome) for road infrastructure projects.

Table A.3.1: Transport Infrastructure Resilience Indicator Rating Cost-to-Completion for Road infrastructure Projects

	FEI	InI	GI	CSI	RSI	FSI
Max Resilience Rating: A A- for InI ∈ [0,61, 0,65] and FSI>0,60	≥ 0,60	≥ 0,65	≥ 0,500	≥ 0,333	≥ 0,150*	
Endogenous Vulnerability Rating: B_{EN} B_{EN}+ for larger values of GI, CSI & RSI B_{EN}- for smaller values of GI B_{EN}- for InI ∈ [0,61, 0,65] and FSI>0,60	≥ 0,60	≥ 0,65	≥ 0,700	[0,333, 0,000]	[0,150, 0,000]	
Exogenous Vulnerability Rating: B_{EX} B_{EX}+ for larger values of GI, CSI & RSI B_{EX}- for smaller values of CSI & RSI B_{EX}- for InI ∈ [0,61, 0,65] and FSI>0,60 B_{EX}- when C+ and FSI >0,666	[0,50, 0,60]	≥0,65	≥0,500	≥0,333	≥0,150	≥0,600
Poor Resilience Rating: C C+ For larger values of GI	<0,50	<0,65	<0,500	<0,333	<0,150	<0,60
Rating: C	∀	∀	∀	∀	∀	→0,00

* *For road projects RSI≤0.400*

Table A.3.2: Transport Infrastructure Resilience Indicator Rating Time-to-Completion for Road infrastructure Projects

	FEI	InI	GI	CSI	RAI	FSI
Max Resilience Rating: A A- for InI ∈ [0,61, 0,65] and FSI<0,60 or GI>0,600	≥0,60	≥0,65	≥0,500	≥0,000		
Endogenous Vulnerability Rating: B_{EN} B_{EN}+ for larger values of GI B_{EN}- for smaller values of GI	≥0,60	≥0,65	≥0,500	[0,000, 0,200]	<0,500	
Exogenous Vulnerability Rating: B_{EX} B_{EX}+ for larger values of GI B_{EX}- for InI ∈ [0,61, 0,65] and GI>0,500	[0,50, 0,60]	≥0,65	≥0,500	[0,000, 0,200]	<0,500	
Poor Resilience Rating: C C+ for larger values of GI or InI	<0,50	<0,65	<0,500	<0,00	>0,500	>0,600

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Table A.3.3: Transport Infrastructure Resilience Indicator Rating Actual vs Forecast Traffic for Road infrastructure Projects

	FEI	InI	GI	CSI	RSI	RAI
Max Resilience Rating: A A- for InI ∈ [0,61, 0,65] and GI>0,600 A- for RAI<0,500	≥0,60	≥0,65	≥0,500	≥0,333	≥0,150*	
Endogenous Vulnerability Rating: B_{EN} B_{EN}+ for larger values of GI and/or CSI and/or RSI B_{EN}+ for RAI>0,500 B_{EN}- for smaller values of GI B_{EN}- for RAI <0,500	≥0,60	≥0,65	≥0,500	[0,000, 0,333]	[0,000, 0,150]	
Exogenous Vulnerability Rating: B_{EX} B_{EX}+ for larger values of GI or CSI or RSI B_{EX}- for RAI <0,500 B_{EX}- for InI ∈ [0,61, 0,65] and GI>0,500	[0,50, 0,60]	≥0,65	≥0,500	≥0,333	≥0,150	>0,500
Poor Resilience Rating: C C+ for larger values of GI or InI C+ for RAI>0,500	<0,50	<0,65	<0,500	<0,00	<0,150	<0,500

* *For road projects RSI≤0.400*

Table A.3.4.: Transport Infrastructure Resilience Indicator Rating Actual vs Forecast Revenue for Road infrastructure Projects

	RRI	RAI	GI	CSI	RSI	FSI
Max Resilience **Rating: A** If Traffic Rating A, then Revenue Rating A And Figure-of-Merit for Traffic outcome B A- for any RRI RAI, GI, CSI, FSI smaller	≥0,666	≥0,666	≥0,500	≥0,333	≥0,150*	≥0,666
Endogenous Vulnerability **Rating: B_{EN}** And Figure-of-Merit for Traffic outcome A, B or C B_{EN}+ for larger values of RAI and/or GI and/or CSI and/or RSI and/or FSI B_{EN}- for smaller values of RAI and/or GI and/or CSI and/or RSI and/or FSI	<0,666	[0,500, 0,600]	≥0,500	[0,000, 0,333]	≥0,150	≥0,500
Exogenous Vulnerability **Rating: B_{EX}** And Figure-of-Merit for Traffic outcome B or C B_{EX}+ for larger values of RAI and/or GI and/or CSI and/or RSI and/or FSI B_{EX}- for smaller values of RAI and/or RRI and/or GI and/or CSI and/or RSI and/or FSI	≥0,666	≥0,500	≥0,500	≥0,333	≥0150	≥0,500
Poor Resilience **Rating: C** And Figure-of-Merit for Traffic outcome C C+ for larger values of RRI or RAI and/or GI and/or CSI and/or RSI and/or FSI	<0,666	<0,500	<0,500	<0,000	<0150	<0,500

* *For road projects RSI≤0.400*

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Urban Transit

A key characteristic in the Transport Infrastructure Resilience Indicator rating of Urban Transit projects is the **emphasis placed on the Institutional (InI) and Governance (GI) indicators and the absence of the Financial-Economic (FEI) indicator.** Also noticeable in the rating of Urban Transit are the relatively large values of the Revenue Support indicator that need to be attained. Tables A.3.5 to A.3.8 present the rating system per outcome.

Table A.3.5: Transport Infrastructure Resilience Indicator Rating Cost-to-Completion for Urban Transit infrastructure Projects

	InI	GI	CSI	RSI
Max Resilience Rating: A A- for RSI ∈ [0,200, 0,400] A- for InI ∈ [0,61, 0,65] and all other with values as indicated A- for smaller values of CSI or RSI	≥0,65	≥0,500	≥0,333	≥0,400*
Endogenous Vulnerability Rating: B_{EN} B_{EN}+ for larger values of GI, CSI & RSI B_{EN} - for GI ∈ [0,500, 0,700]; if GI< 0,500 then C+ B_{EN} - for smaller values of CSI or RSI	≥0,65	≥0,700	[0,200, 0,333]	[0,200, 0,400]
Exogenous Vulnerability Rating: B_{EX}	FEI does not have a specific direct impact on Urban transit and InI has to have a value InI>0,65 in all conditions leading to positive outcomes			
Poor Resilience Rating: C C+ For larger values of GI and/or CSI and/or RSI	<0,65	<0,500	<0,333	<0,150

* *For urban transit projects RSI≤ 0.933*

Table A.3.6: Transport Infrastructure Resilience Indicator Rating Time-to-Completion for Urban Transit infrastructure Projects

	InI	GI	CSI	RSI
Max Resilience Rating: A A- for RSI ∈ [0,200, 0,400]	≥0,65	≥0,500	≥0,333	≥0,400*
Endogenous Vulnerability Rating: B_{EN} B_{EN}+ for larger values of GI, CSI & RSI B_{EN} - for GI ∈ [0,500, 0,700]; if GI< 0,500 then C+ B_{EN} - for smaller values of CSI or RSI	≥0,65	≥0,700	[0,200, 0,333]	[0,200, 0,400]
Exogenous Vulnerability Rating: B_{EX}	FEI does not have a specific direct impact on Urban transit and InI has to have a value InI>0,65 in all conditions leading to positive outcomes			
Poor Resilience Rating: C C+ For larger values of GI and/or CSI and/or RSI	<0,65	<0,500	<0,333	<0,150

* *For urban transit projects RSI≤ 0.933*

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Table A.3.7: Transport Infrastructure Resilience Indicator Rating Actual vs Forecast Traffic for Urban Transit infrastructure Projects

	InI	GI	CSI	RSI	LoC	RAI
Max Resilience Rating: A A- for RSI ∈ [0,200, 0,400] A- for InI ∈ [0,61, 0,65] and all other with values as indicated A- for smaller values of CSI or RSI	≥ 0,65	≥ 0,500	≥ 0,333	≥ 0,400*	≥ 0,500	
Endogenous Vulnerability Rating: B_{EN} B_{EN}+ for larger values of GI, CSI & RSI B_{EN} - for GI ∈ [0,500, 0,700] or CSI or RSI ∈ [0,000, 0,200] RAI > 0,500 supports	≥ 0,65	≥ 0,700	[0,200, 0,333]	[0,200, 0,400]	≥ 0,500	≥ 0,500
Exogenous Vulnerability Rating: B_{EX}	FEI does not have a specific direct impact on Urban transit and InI has to have a value InI>0,65 in all conditions leading to positive outcomes					
Poor Resilience Rating: C C+ For larger values of GI and/or CSI and/or RSI	<0,65	<0,500	<0,333	<0,150	<0,500	<0,500

* *For urban transit projects RSI≤ 0.933*

Table A.3.8: Transport Infrastructure Resilience Indicator Rating Actual vs Forecast Revenue for Urban Transit infrastructure Projects

	InI	GI	CSI	RSI	LoC	RAI	RRI
Max Resilience Rating: A If traffic rating A, then Revenue Rating A A- for RSI ∈ [0,200, 0,400] A- for InI ∈ [0,61, 0,65] and all other with values as indicated A- for smaller values of CSI or RSI	≥ 0,65	≥ 0,500	≥ 0,333	≥ 0,400*	≥ 0,500	≥ 0,500	≥ 0,500
Endogenous Vulnerability Rating: B_{EN} If traffic rating B_{EN}, then Revenue Rating B_{EN} Or **At least two indicators with values greater than indicated** B_{EN}+ If more than two indicators with values greater than indicated InI >0,65 always	≥0,65	0,500	0,333	0,400	0,500	0,500	0,500
Exogenous Vulnerability Rating: B_{EX}	FEI does not have a specific direct impact on Urban transit and InI has to have a value InI>0,65 in all conditions leading to positive outcomes						
Poor Resilience Rating: C C+ For larger values of GI and/or CSI and/or RSI or RRI	<0,65	<0,500	<0,333	<0,150	<0,500	<0,500	<0,500

* *For urban transit projects RSI≤ 0.933*

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Bridge & Tunnel Projects

Bridge and Tunnel projects may be considered as special cases of road projects. Their key characteristics focus around their exclusivity in the network, the preferred remuneration scheme, which is usually demand-based, and the high public sector contribution to their financing. Hence, bridge and tunnel projects are based on the Transport Infrastructure Resilience Indicator rating approach applied to roads with the consideration of high Revenue Support (especially the factor Level of Coopetition), low Remuneration Attractiveness and high Financing Scheme Indicator values.

Table A.3.9: Transport Infrastructure Resilience Indicator Rating Cost-to-Completion for Bridge & Tunnel infrastructure Projects

	FEI	InI	GI	CSI	RSI	LoC	FSI
Max Resilience Rating: A A- for InI ∈ [0,61, 0,65] and LoC>0,500	≥ 0,60	≥ 0,65	≥ 0,500	≥ 0,333	≥ 0,250*	≥ 0,500	
Endogenous Vulnerability Rating: B_{EN} B_{EN}+ for larger values of GI, CSI & RSI B_{EN} - for smaller values of GI, CSI & RSI B_{EN} - for InI ∈ [0,61, 0,65] and LoC>0,500 If GI< 0,400 then C+	≥0,60	≥0,65	≥0,500	[0,000, 0,333]	[0,150, o,250]	≥ 0,500	
Exogenous Vulnerability Rating: B_{EX} B_{EX} + for larger values of GI, CSI & RSI B_{EX} - for smaller values of CSI & RSI B_{EX} - for InI ∈ [0,61, 0,65] and LoC>0,500 B_{EX}- when C+ and FSI > 0,666 or LoC>0,700	[0,50, 0,60]	≥0,65	≥ 0,500	≥ 0,333	≥ 0,150	≥ 0,700	≥ 0,600
Poor Resilience Rating: C C+ For larger values of GI	<0,50	<0,65	<0,500	<0,333	<0,150	<0,500	<0,60

* *For bridge & tunnel projects RSI≤ 0.533*

Table A.3.10: Transport Infrastructure Resilience Indicator Rating Time-to-Completion for Bridge & Tunnel infrastructure Projects

	FEI	InI	GI	CSI	RSI	LoC	RAI	RRI	FSI
Max Resilience Rating: A A- for InI ∈ [0,61, 0,65] and LoC>0,700 or GI>0,600	≥ 0,60	≥ 0,65	≥ 0,500	≥ 0,250	≥ 0,250*	≥ 0,500	RAI <0,500 Or/and RRI <0,500		≥ 0,500
Endogenous Vulnerability Rating: B_{EN} B_{EN}+ for larger values of GI or LoC B_{EN}- for smaller values of GI C+ for GI <<0,500 & RAI >0,500	≥ 0,60	≥ 0,65	≥ 0,500	[0,000, 0,250]	≥ 0,250	≥ 0,500	RAI <0,500 Or RRI <0,500		≥ 0,500
Exogenous Vulnerability Rating: B_{EX} B_{EX}+ for larger values of GI B_{EX}- for InI ∈ [0,61, 0,65] and GI>>0,500 or LoC>>0,500	[0,50, 0,60]	≥ 0,65	≥ 0,500	≥ 0,000	≥ 0,250	≥ 0,500	RAI <0,500 Or RRI <0,500		>0,500
Poor Resilience Rating: C C+ For larger values of GI or InI or LoC	<0,50	<0,65	<0,500	<0,00	<0,250	0,500	RAI <0,500 Or RRI <0,500		>0,600

* *For bridge & tunnel projects RSI≤ 0.533*

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Table A.3.11: Transport Infrastructure Resilience Indicator Rating Actual vs Forecast Traffic for Bridge & Tunnel infrastructure Projects

	FEI	InI	GI	CSI	RSI	LoC	RAI	FSI
Max Resilience Rating: A A- for InI ∈ [0,61, 0,65] and GI>0,600 A- for RAI<0,500	≥ 0,60	≥ 0,65	≥ 0,500	≥ 0,333	≥ 0,250*	≥ 0,500	<0,500	>0,500
Endogenous Vulnerability Rating: B_{EN} B_{EN}+ for larger values of GI and/or CSI and/or RSI B_{EN}- for smaller values of GI B_{EN}- for InI ∈ [0,61, 0,65] and GI>0,500 & LoC>>0,500 C+ if RSI<0,150 & LoC<0,500 & RAI<0,500	≥ 0,60	≥ 0,65	≥ 0,500	[0,000, 0,333]	[0,150, 0,250]	≥0,500	<0,500	>0,500
Exogenous Vulnerability Rating: B_{EX} B_{EX}+ for larger values of GI or CSI or RSI B_{EX}- for InI ∈ [0,61, 0,65] and GI>0,500	[0,50, 0,60]	≥ 0,65	≥ 0,500	≥ 0,333	≥ 0,250	≥ 0,500	<0,500	>0,500
Poor Resilience Rating: C C+ For larger values of GI or InI or LoC	<0,50	<0,65	<0,500	<0,00	<0,150	0,500	<0,500	>0,500

* *For bridge & tunnel projects RSI≤ 0.533*

Due to limited information and data, the B rating cannot be assessed for revenue. However, the respective assessment for roads could be applied for the characteristics (indicator values) of bridge and tunnel projects. Notably, the Institutional indicator is also important for these projects. As in the case of roads, the Transport Infrastructure Resilience Indicator rating with respect to the figure-of-merit Actual vs Forecast Traffic is also important and should be taken into account in the revenue rating.

Table A.3.12: Transport Infrastructure Resilience Indicator Rating Actual vs Forecast Revenue for Bridge & Tunnel infrastructure Projects

	InI	RRI	RAI	GI	CSI	RSI	FSI
Max Resilience **Rating: A** If Traffic Rating A, then Revenue Rating A And Figure-of-Merit for Traffic outcome B A- for any RAI, GI, CSI, FSI smaller	≥ 0,65	≥0,666	<0,500	≥ 0,500	≥ 0,333	≥ 0,250*	≥ 0,666
Poor Resilience **Rating: C** And Figure-of-Merit for Traffic outcome C C+ for larger values of RAI and/or GI and/or CSI and/or RSI and/or FSI	<0,65	<0,500	<0,500	<0,500	<0,000	<0,150	<0,500

* *For bridge & tunnel projects RSI≤ 0.533*

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Airport Projects

The comparative analysis identified the limitations of the BENEFIT Matching Framework and, more specifically, the structure of the Financial–Economic Indicator to address airport projects as their operation takes place within a wider implementation environment. In this context, it is possible to customise the Transport Infrastructure Resilience Indicator rating system for the Cost-to-Completion and Time-to-Completion outcomes but not for Actual vs Forecast Traffic and Revenue.

Table A.3.13: Transport Infrastructure Resilience Indicator Rating Cost-to-Completion for Airport infrastructure Projects

	FEI	InI	GI	CSI	RSI	LoC	FSI
Max Resilience Rating: A A- for InI ∈ [0,61, 0,65] and LoC>0,500	≥ 0,60	≥ 0,65	≥ 0,500	≥ 0,333	≥ 0,400*	≥ 0,500	≥ 0,500
Endogenous Vulnerability Rating: B_{EN} B_{EN}+ for larger values of GI, CSI & RSI B_{EN} - for smaller values of GI, CSI & RSI B_{EN} - for InI ∈ [0,61, 0,65] and LoC>0,500 If GI< 0,400 then C+	≥ 0,60	≥ 0,65	≥ 0,500	[0,000, 0,333]	[0,200, 0,400]	≥ 0,500	≥ 0,500
Exogenous Vulnerability Rating: B_{EX} B_{EX} + for larger values of GI, CSI & RSI B_{EX} - for smaller values of CSI B_{EX} - for InI ∈ [0,61, 0,65] and LoC>0,500 B_{EX}- when C+ and FSI > 0,666 or LoC>0,700	[0,50, 0,60]	≥0,65	≥0,500	≥0,333	≥0,400	≥0,700	≥0,600
Poor Resilience Rating: C C+ For larger values of GI	<0,50	<0,65	<0,500	<0,333	<0,150	<0,500	<0,60

* *For airport projects RSI≤ 0.933*

Table A.3.14: Transport Infrastructure Resilience Indicator Rating Time-to-Completion for Airport infrastructure Projects

	FEI	InI	GI	CSI	RSI	LoC	RAI RRI	FSI
Max Resilience Rating: A A- for InI ∈ [0,61, 0,65] and LoC>0,700 or GI>0,600	≥ 0,60	≥ 0,65	≥ 0,500	≥ 0,250	≥ 0,400*	≥ 0,500	RAI <0,500 Or/and RRI <0,500	≥ 0,500
Endogenous Vulnerability Rating: B_{EN} B_{EN}+ for larger values of GI or LoC B_{EN}- for smaller values of GI C+ for GI <<0,500 & RAI >0,500	≥0,60	≥0,65	≥ 0,500	[0,000, 0,250]	[0,200, 0,400]	≥ 0,500	RAI <0,500 Or RRI <0,500	≥ 0,500
Exogenous Vulnerability Rating: B_{EX} B_{EX}+ for larger values of GI B_{EX}- for InI ∈ [0,61, 0,65] and GI>>0,500 or LoC>>0,500	[0,50, 0,60]	≥0,65	≥0,500	[0,000, 0,250]	≥ 0,400	≥ 0,500	RAI <0,500 Or RRI <0,500	>0,500
Poor Resilience Rating: C C+ For larger values of GI or InI or LoC	<0,50	<0,65	<0,500	<0,00	<0,250	0,500	RAI <0,500 Or RRI <0,500	>0,60

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Port Projects

The comparative analysis of findings identified that the BENEFIT Matching Framework, in its current configuration and structure, is unable to explain the performance of port projects. Stemming from this conclusion the customisation of the Transport Infrastructure Resilience Indicator rating methodology for ports is not possible.

Rail Projects

The BENEFIT case database included a very small sample of cases, for which furthermore there was limited information. Due to this limitation, the Rail project performance could not be studied.

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Annex 4. BENEFIT Project Cases

The project listed in table A.4.1 were the cases the various BENEFIT analyses were based upon.

All project cases and their over-time information was employed in the **qualitative analysis** per mode[80]. All project cases depending on the availability of information over time were also used for the **descriptive statistics analysis**[81] and the **typology/indicator factors analyses**[82]. Selected cases were employed in the **cause & effect analyses**[83]. Only project cases for which indicator information was available over time could be used in the indicator based analyses (fsQCA, IA and econometric models).

For the needs of the BENEFIT project, information was needed over the life cycle of the project in order to construct indicator value sets (snapshots) over time. The fsQCA selected only one project snapshot per analysis. The selected snapshot was selected depending on the scope of the analysis to be conducted. Importance and Econometrics analyses could use all snapshots following the snapshot representing award/financial close by selecting appropriate models.

Table A.4.1 indicates the project cases for which information for snapshots following the award/financial close could be constructed (see table comments) and the respective number of snapshots. The table also includes the origin of the project cases:

- TU1001 denotes project cases on which information was initially collected under COST Action TU1001 and updated to the needs of the BENEFIT project.
- OMEGA denotes project cases on the OMEGA website. Further information on these projects could not be collected.
- BENEFIT denotes project cases collected under the BENEFIT project.

Table A.4.1: Projects included in the BENEFIT Analyses

#	Project Title	Origin	Author	Country	Indicator Analyses	# of used snap-shots[84]	Comments
PPP Projects							
Road Projects							
1.	Attiki Odos (Athens Ring Road)	TU1001	UAEGEAN	Greece	Yes	4	
2.	Brebemi		TRT	Italy	No		Missing Indicator and Outcome Information
3.	Horgos – Pozega	TU1001	UoB	Serbia	No		Cancelled project
4.	Ionia Odos Motorway	TU1001	UAEGEAN	Greece	No	2	Used to check against findings
5.	Central Greece (E65) Motorway		UAEGEAN	Greece	No	2	
6.	BNRR (M6 Toll)	TU1001	UCLAN	UK	Yes	4	
7.	M80 Haggs	TU1001	UCLAN	UK	Yes	2	
8.	A19 Dishforth To Tyne Tunnel	TU1001	UCLAN	UK	Yes	2	
9.	A22 – Algarve	TU1001	IST	Portugal	Yes	2	
10.	Radial 2 Toll Motorway	TU1001	UCLAN	Spain	Yes	4	
11.	Eje Aeropuerto (M-12). Airport Axis Toll Motorway	TU1001	UCLAN	Spain	Yes	4	
12.	M-45	TU1001	UCLAN	Spain	Yes	4	
13.	A2 Motorway Poland	TU1001	IBDiM	Poland	Yes	1	

[80] See BENEFIT Deliverables D4.2 and D4.4.

[81] See BENEFIT Deliverable D4.1.

[82] See BENEFIT Deliverables D3.1; D4.2; and D4.4.

[83] See BENEFIT Deliverable D4.3.

[84] Number of snapshots excluding award/financial close and all other snapshots representing points in the project life cycle prior to award/financial close.

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#	Project Title	Origin	Author	Country	Indicator Analyses	# of used snap-shots[84]	Comments
14.	Istrian Y	TU1001	UAEGEAN	Croatia	No		Used to check against findings
15.	A23 - Beira Interior	TU1001	IST	Portugal	Yes	2	
16.	E39 Orkdalsvegen Public Road	TU1001	UAEGEAN	Norway	Yes	3	
17.	Elefsina Korinthos Patra Pyrgos Tsakona Motorway	TU1001	UAEGEAN	Greece	Yes	2	
18.	Via-Invest Zaventem	TU1001	UA	Belgium	Yes	1	
19.	E18 Grimstad – Kristiansand	TU1001	UAEGEAN	Norway	No		Depletion of partner resources
20.	M-25 Motorway London Orbital	BENEFIT	UCLAN	UK	Yes	2	
21.	Moreas Motorway	BENEFIT	UAEGEAN	Greece	No	1	Used to check against findings
22.	C-16 Terrassa-Manresa Toll Motorway	TU1001	ULPGC	Spain	Yes	2	
23.	E4 Helsinki-Lahti	TU1001	OULU	Finland	Yes	4	
24.	E18 Muurla-Lohja	TU1001	OULU	Finland	Yes	3	
Bridge & Tunnel Projects							
25.	Rion-Antirion Bridge	TU1001	UAEGEAN	Greece	Yes	3	
26.	Lusoponte - Vasco Da Gama Bridge	TU1001	TIS	Portugal	Yes	1	
27.	Coen Tunnel	TU1001	UT	The Nether-lands	No		Missing Indicator Information
28.	Herrentunnel Lüebeck	BENEFIT	KIT	Germany	Yes	2	
29.	Millau Viaduct	OMEGA	UCL-OMEGA	France	No		Missing Indicator and Outcome Information
30.	The Oresund Link	OMEGA	UCL-OMEGA	Sweden - Denmark	No		
Port Projects							
31.	Piraeus Container Terminal	TU1001	UAEGEAN	Greece	Yes	2	
32.	Port of Sines Terminal XXI	TU1001	IST	Portugal	Yes	2	
33.	Port of Leixoes	TU1001	TIS	Portugal	Yes	1	
34.	Deurganckdoksluis-Deurganckdock Lock	TU1001	UA	Belgium	Yes	1	
35.	Venice Offshore - Onshore Terminal	BENEFIT	UA	Italy	No		Tender Info only
36.	Larnaka Port & Marina Re-Development	TU1001	UAEGEAN	Cyprus	No		Did not reach financial close
37.	Valencia Cruise Terminal	TU1001	ULPGC	Spain	No		Tender Info only
38.	Terminal Muelle Costa at Port of Barcelona	TU1001	ULPGC	Spain	Yes	1	
39.	Barcelona Europe South Terminal	TU1001	ULPGC	Spain	Yes	1	
40.	Adriatic Gateway Container Terminal	TU1001	UAEGEAN	Croatia	No		Depletion of partner resources
Airport Projects							
41.	Athens International Airport 'Eleftherios Venizelos'	BENEFIT	UAEGEAN	Greece	Yes	3	
42.	Larnaca and Paphos International Airports	TU1001	UAEGEAN	Cyprus	Yes	3	
Rail Projects							
43.	Fertagus Train	TU1001	IST	Portugal	Yes	2	

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#	Project Title	Origin	Author	Country	Indicator Analyses	# of used snap-shots[84]	Comments
44.	Liefkenshoekspoor-verbinding -Liefkenshoek Rail Link	BENEFIT	UA	Belgium	Yes	1	
Urban Transit Projects							
45.	Metrolink LRT, Manchester	TU1001	UCLAN	UK	Yes	4	
46.	Reims Tramway	TU1001	CEREMA	France	Yes	2	
47.	Caen-TVR	TU1001	CEREMA	France	No		Missing Indicator Information
48.	Brabo 1	TU1001	UA	Belgium	Yes	1	
49.	MST - Metro Sul do Tejo	TU1001	IST	Portugal	Yes	3	
50.	Metro de Malaga	BENEFIT	UCLAN	Spain	Yes	2	
51.	Metro do Porto S.A.	BENEFIT	IST	Portugal	Yes	1	
52.	Velo'V	BENEFIT	CEREMA	France	Yes	1	
53.	SERVICI	TU1001	ULPGC	Spain	No	1	
Terminal Projects							
54.	Quadrante Europa Terminal Gate	BENEFIT	TRT	Italy	No		Missing Indicator and Outcome Information
55.	Central Public Transport Depot of the City of Pilsen	BENEFIT	UAEGEAN	Czech Republic	Yes	1	Only full sample analysis
Public Financed Projects							
Road Projects							
1.	Combiplan Nijverdal	BENEFIT	UT	The Nether-lands	Yes	2	
2.	A5 Maribor - Pince Motorway	BENEFIT	UAEGEAN	Slovenia	Yes	2	
3.	Koper - Izola Expressway	BENEFIT	UAEGEAN	Slovenia	Yes	2	
4.	Motorway E-75, Section Horgos - Novi Sad (2nd Phase)	BENEFIT	UoB	Serbia	Yes	1	
5.	Belgrade By-Pass Project, Section A: Batajnica-Dobanovci	BENEFIT	UoB	Serbia	Yes	2	
6.	Motorway E-75, Section Donji Neradovac - Srpska Kuca	BENEFIT	UoB	Serbia	Yes	2	
7.	Estradas de Portugal	BENEFIT	TIS	Portugal	No		Did not refer to specific project
8.	Bundesautobahn 20	OMEGA	UCL-OMEGA	Germany	No		Missing Indicator and Outcome Information
Bridge & Tunnel Projects							
9.	Berlin Tiergarten Tunnel	OMEGA	UCL-OMEGA	Germany	No		
10.	Sodra Lanken (The Southern Link)	OMEGA	UCL-OMEGA	Sweden	No		
11.	Blanka Tunnel Complex	BENEFIT	UAEGEAN	Czech Republic	Yes		
Port Projects							
12.	OW-Plan Oostende-Integrated Coastal & Maritime Plan for Oostende	BENEFIT	UA	Belgium	No		Not suitable
13.	Port of Agaete	BENEFIT	ULPGC	Spain	Yes	2	
Airport Projects							
14.	Modlin Regional Airport	BENEFIT	IBDiM	Poland	Yes	3	
15.	Berlin Brandenburg Airport (BER)	BENEFIT	KIT	Germany	Yes	1	

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#	Project Title	Origin	Author	Country	Indicator Analyses	# of used snap-shots[84]	Comments
16.	Sa Carneiro Airport Expansion	BENEFIT	IST	Portugal	No		Missing Indicator
Rail Projects							
17.	Gardermobanen (Airport Exprestrain)	BENEFIT	UAEGEAN	Norway	No		Depletion of partner resources
18.	NBS Köln-Rhein/Main	OMEGA	UCL-OMEGA	Germany	No		Missing Indicator and Outcome Information
19.	TGV Mediterranean	OMEGA	UCL-OMEGA	France	No		
20.	HSL-Zuid	OMEGA	UCL-OMEGA	The Nether-lands	No		
21.	MXP T2-Railink-up	BENEFIT	TRT	Italy	No		
22.	Randstadrail	OMEGA	UCL-OMEGA	The Nether-lands	No		Missing Indicator and Outcome Information
Urban Transit Projects							
23.	Tram-Train 'Kombiloesung' Karlsruhe	BENEFIT	KIT	Germany	Yes	1	
24.	Tram T4 (Line 4 Of Lyon Tramway)	BENEFIT	CEREMA	France	Yes	2	
25.	Athens Tramway	BENEFIT	UAEGEAN	Greece	Yes	6	
26.	Warsaw's Metro II-nd Line	BENEFIT	IBDiM	Poland	Yes	1	
27.	London Underground Jubilee Line Extension (JLE)	OMEGA	UCL-OMEGA	UK	No		Missing Indicator and Outcome Information
28.	Meteor	OMEGA	UCL-OMEGA	France	No		
29.	Attiko Metro (Athens Metro Base Project)	OMEGA	UCL-OMEGA	Greece	No		
30.	Beneluxlijn	OMEGA	UCL-OMEGA	The Nether-lands	No		
31.	Randstadrail	OMEGA	UCL-OMEGA	The Nether-lands	No		Missing Indicator and Outcome Information
Terminal Projects							
32.	The Hague New Central Train Station	BENEFIT	UT	The Nether-lands	Yes	1	Only Full sample analysis

LRT = Light Rail Transit

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End of Report

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