Public-Private Partnerships in Port Areas
Lessons Learned from Case Studies in Antwerp and Rotterdam

Wiegmans, Bart; Mouter, Niek; Vanelslander, Thierry; Verweij, Stefan

DOI
10.1007/978-3-030-83484-5_7

Publication date
2022

Document Version
Final published version

Published in
Competitive Government

Citation (APA)
Wiegmans, B., Mouter, N., Vanelslander, T., & Verweij, S. (2022). Public-Private Partnerships in Port Areas: Lessons Learned from Case Studies in Antwerp and Rotterdam. In S. Hakim, R. M. Clark, & E. A. Blackstone (Eds.), *Competitive Government: Public Private Partnerships* (pp. 107-128). (Competitive Government: Public Private Partnerships). Springer. https://doi.org/10.1007/978-3-030-83484-5_7

Public-Private Partnerships in Port Areas: Lessons Learned from Case Studies in Antwerp and Rotterdam

Bart Wiegmans, Niek Mouter, Thierry Vanelslander, and Stefan Verweij

Abstract The cost-benefit analysis (CBA) is a widely used approach for the appraisal of transport projects, but criticisms on it have led to the development of alternatives such as the BENEFIT approach. This book chapter analyzes three cases of infrastructure investments in port areas in Belgium and the Netherlands, by application of the BENEFIT approach. We find inter alia that differences in country performance on internationally accepted indicators can influence differences in infrastructure investments between countries. Moreover, infrastructure projects with larger revenue-generating possibilities will influence the PPP (public-private partnership) potential of this type of projects in a positive way. Applying different appraisal methods to the same infrastructure project might help to arrive at infrastructure project investment approvals that are well-documented.

Keywords PPP · Cooperation · Port areas

B. Wiegmans (✉)
Department of Transport & Planning, Faculty of Civil Engineering and Geosciences, Delft University of Technology, Delft, The Netherlands
e-mail: b.wiegmans@tudelft.nl

N. Mouter
Section Transport & Logistics, Faculty of Technology, Policy and Management, Delft University of Technology, Delft, The Netherlands
e-mail: n.mouter@tudelft.nl

T. Vanelslander
Department of Transport and Regional Economics, Faculty of Business and Economics, University of Antwerp, Antwerp, Belgium
e-mail: thierry.vanelslander@uantwerp.be

S. Verweij
Department of Spatial Planning and Environment, Faculty of Spatial Sciences, University of Groningen, Groningen, The Netherlands
e-mail: s.verweij@rug.nl; http://www.stefanverweij.eu

S. Hakim et al. (eds.), *Handbook on Public Private Partnerships in Transportation, Vol I*, Competitive Government: Public Private Partnerships,
https://doi.org/10.1007/978-3-030-83484-5_7

Abbreviations

BENEFIT	The BENEFIT project operationalized through its transport infrastructure resilience indicator provides a rating methodology, which gives the likelihood of an infrastructure project in its current configuration to reach its stated outcomes with respect to cost to construction completion, time to construction completion, actual vs forecast traffic, and revenues.
CBA	Cost-benefit analysis
CSI	Cost-saving
D&C	Design-and-construct
DBFM	Design-build-finance-maintain
FEI	Financial-economic
FSI	Financing scheme
GI	Governance
InL	Institutional
IRA	Reliability/availability
KDL	Kieldrecht lock
LHRT	Liefkenshoek Rail Tunnel project
MEAI	Market efficiency and acceptability
MV2	Second Maasvlakte
PPP	Public-private partnership
PSC	Public Sector Comparator
QCA	Qualitative comparative analysis
RAI	Remuneration attractiveness
RRI	Revenue robustness
RSI	Revenue support
VfM	Value for money

Introduction

It has been traditional for governments to decide on and directly finance transportation infrastructure investments. However, the introduction of market principles, more liberal viewpoints, deregulation, and privatization have resulted in a more competitive, market-based transport sector, in which the government does not need to finance all investments in infrastructure (Wiegmans et al. 2002).

As a result of this change in attitude, public-private partnerships (PPPs) for transportation infrastructure have become popular among policy makers (European PPP Expertise Centre, 2015). However, despite their apparent advantages, the involvement of private parties in investing in transport infrastructure has remained limited, and it has proven challenging to implement PPPs successfully (e.g., Verweij et al., 2017). However, successful PPPs have been implemented in, for instance, container terminal investments in large deep-sea ports, where port authorities collaborate with large deep-sea container carriers and/or global terminal operating companies.

The purpose of this chapter is to identify the factors that affect success and failure for the development of PPPs in port areas. Hopefully, this can contribute to the development of effective PPP design. The research question of this chapter is as follows: which success and failure factors can be identified from PPP experiences in the port areas of Antwerp and Rotterdam and how can this inform effective PPP design? We aim to answer this research question through an analysis of three case studies in freight transportation in the port areas of Antwerp (Belgium) and Rotterdam (the Netherlands). "Public Private Partnerships in the port areas of Antwerp and Rotterdam" section briefly describes the respective port areas and introduces the PPP projects. "Evaluation Frameworks: CBA, PSC, and BENEFIT" section discusses the theoretical approaches toward PPP and concludes with our suggested framework to evaluate the projects. "The Three Infrastructure Projects Compared and Evaluated" section contains the analyses of the PPP projects and indicates the lessons learnt. Finally, "Conclusions and Discussion" section ends with the conclusions and discussion.

Public-Private Partnerships in the Port Areas of Antwerp and Rotterdam

This section addresses the context and relevant characteristics of the three considered PPP cases. The full analysis of the PPP characteristics is done in "The Three Infrastructure Projects Compared and Evaluated" section, with the selected methodology from "Evaluation Frameworks: CBA, PSC, and BENEFIT" section.

Liefkenshoek Rail Tunnel (LHRT)

The Port of Antwerp was served by a common railroad connection to the hinterland, causing congestion and delays (see Fig. 1). The Liefkenshoek Rail Tunnel project (LHRT) was designed to address this problem, as the new railroad would accommodate and allow for growth (Petit, 2015). The Liefkenshoek Rail Link project is the largest PPP project in Belgium. LOCORAIL NV, a consortium of construction groups CFE, VINCI Concessions, and BAM PPP, was chosen after competitive bidding with a 42-year concession contract to design, build, finance, and maintain (DBFM) the Liefkenshoek Rail Link project with a total value of approximately

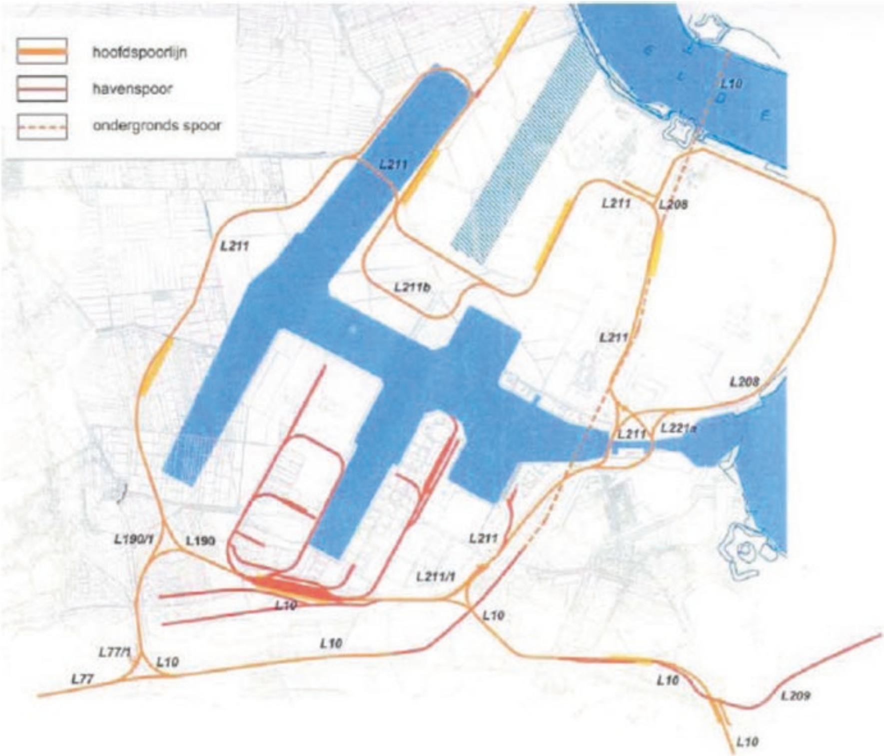

Fig. 1 Overview of rail network in the Port of Antwerp. *Legend:* Hoofdspoorlijn = main rail line, Havenspoor = port rail line, Ondergronds spoor = underground rail line. *Source:* https://www.antwerpen.be/docs/Stad/Stadsvernieuwing/Bestemmingsplannen/RUP_02000_212_00067_00001/RUP_02000_212_00067_00001_0000Document_tn.html

€690 million (Bamelis, 2015; Van Olmen, 2015). The project includes two single-track tunnels of roughly 5970 m in length each and with an internal diameter of 7.3 m, constructed by shield driving, and several kilometers of the tunnels were constructed by cut-and-cover with deep diaphragm and cement-bentonite walls. The total project is divided into 13 construction sections including an aqueduct, the renovation of the existing 30-year-old Beveren Tunnel, the starting shaft, and two tunnels with cross-passages and evacuation shafts, as well as the end ramp. Construction began in November 2008. The critical part of the project was the construction of the starting shaft, as both tunnels depended on this to remain on schedule. The excavation for the first tunnel started in January 2010 and construction for the second tunnel started 2 months later in March 2010. Construction works were completed in February 2014, and the railroad has been operational since the 14th of December 2014. The works were financed by the European Investment Bank and six commercial banks. Infrabel, the Belgian rail network manager, pays an annual availability fee of €50 million to Locorail until 2051 (TUC Rail, 2015).

Second Maasvlakte (MV2)

The Second Maasvlakte (MV2) has been financed primarily by the Port of Rotterdam Authority. The port authority borrowed money from the European Investment Bank (€900 million), the Bank Nederlandse Gemeenten (€450 million), and a bank consortium consisting of ING, Fortis, and Rabobank for a loan of €450 million. The total loan is meant to finance the MV2 and the infrastructure in the Port of Rotterdam. The consortium PUMA, composed of the companies Boskalis and Van Oord, has built the first phase of MV2. The companies VolkerWessels and BAM have been responsible for building the quays, railways, and roads. The project's main aim was to reclaim land from the sea and to build an additional port area that will be primarily used to accommodate new container terminals. In September 2008, after years of discussions, planning, and protests, the building of the MV2 started (the orange part in Fig. 2) and was finished after approximately 5 years, in May 2013, for a

Fig. 2 Overview of the Maasvlakte 2 project in the port of Rotterdam. *Source:* https://nl.wikipedia.org/wiki/Tweede_Maasvlakte#/media/Bestand:MV2_plankaart_Gr_tcm81-33695.jpg

budget of around €3 billion. The project Maasvlakte 2 was realized by the Port of Rotterdam Authority on own account and risk, and in the end, the project was finished on budget.

Kieldrecht Lock (KDL)

The development on the left bank of the Port of Antwerp dates back to the 1970s and started from the Waasland Channel, with the construction of the north and south docks. In the original development plans, a disclosure of the Waasland Port toward the Scheldt river at the seaside was scheduled via the Baalhoek Channel and the related Baalhoek Lock. The Kallo Lock would thereby only function as a transit lock. The seaside access was never completed, and the Kallo Lock, which has been operational since 1983, is the only access way to the Waasland Port. In 1998–1999, when the choice was made for the Deurganckdok and a further development via that way, it was decided to remove the reservation area for the Baalhoek Channel from the regional development plan. The Kallo Lock is heavily used with 8800 shifts per year. Waiting times amount to 3.5 h. Given its dimensions (360 m × 50 m × 12.58 m), the lock was never meant to function as access lock from the seaside. Moreover, there is always the chance that a collision at the level of the lock would block the entire Waasland Port. The new Kieldrecht Lock (KDL) is bigger than the current Kallo Lock and will hence allow using the Waasland Port's potential to the maximum. The new lock is not only larger and longer then the Kallo Lock but also deeper. With the increased growth of the activities in the Waasland Port, the Kallo Lock will reach its capacity. A second lock on the Scheldt left bank offers the Port of Antwerp operational reliability in the case the Kallo Lock would not be accessible for shipping traffic. During periods of maintenance or repair works, there is then no problem, as the ships can sail in and out the Waasland Port via the second lock. The total costs for the lock are €382.3 million. The contract was awarded for a 20-year period to NV Deurganckdoksluis; a PPP consortium owned 26% by NV Vlaamse Havens (public) and Port of Antwerp (private). The call was launched in November 2010, the contract was approved, and the financing was closed in November 2011 (Regering, 2012). Financing was provided by the European Investment Bank, KBC, and the contractor. The lock was opened for usage in 2016 (Fig. 3).

Fig. 3 Overview of the location of the Kieldrechtsluis. *Source:* https://nl.wikipedia.org/wiki/Kieldrechtsluis

Evaluation Frameworks: CBA, PSC, and BENEFIT

Cost-Benefit Analysis (CBA)

In most high-income countries, CBA or CBA techniques form the core of the economic appraisal of transport projects (e.g., Andersson et al., 2018; Mackie et al., 2014). In the Netherlands, it is obligatory to evaluate proposed investments in port infrastructure that require a financial contribution from a national government using a CBA. The Dutch government also developed guidelines which CBA analysts should follow when conducting their studies (e.g., Romijn & Renes, 2013).

Basically, a CBA is an overview of all the positive effects (benefits) and negative effects (costs) of a project or policy option (e.g., Van Wee, 2012). All impacts are quantified as far as possible and expressed in monetary terms using the notion of households' willingness to pay for these effects (e.g., Boadway, 2006). Finally, government projects are typically intertemporal in nature, so the benefits and costs occur over a period of time (e.g., Boadway, 2006). To deal with this, they are presented as the so-called present values, implying that—even after a correction for inflation—it is better to have 1 euro or dollar now than, for example, in 10 years' time (Van Wee, 2012). Present values are aggregated to yield an indicator of the project's net impact on social welfare.

Investments in port areas generally also require financial support from the government, notwithstanding the desire to create a more competitive, market-based transport sector, in which the government does not need to finance all investments in infrastructure (Wiegmans et al., 2002). Hence, in the Netherlands, CBAs were conducted for various port investments in the past two decades, ranging from relatively small local projects such as new locks in inland waterways (tens of million euro investments) to the Second Maasvlakte project, which is a billion euro expansion of the Port of Rotterdam (Annema et al., 2017). Annema et al. (2017) observed that in the period 2000–2012, 14 CBAs were conducted for investments in inland waterway projects, and 8 CBAs were conducted for investments in seaports in the Netherlands.

Two Dutch studies offered in-depth analyses of CBAs for seaport projects. Annema et al. (2017) focused on the CBA that was conducted for the Second Maasvlakte project (see "Second Maasvlakte (MV2)" section). Annema et al. (2017) concluded that the CBA was used as a learning tool and not as a decision-making tool in these two cases. They established that in the case of the Second Maasvlakte, the CBA fueled the decision to implement the extension of the port in phases (depending on the arrival of new customers for the port grounds). The fact that in these cases CBA was used as an optimization instrument and not as a decision instrument echoes findings in the more general CBA literature (Eliasson & Lundberg, 2012; Hahn & Tetlock, 2008; Mouter et al., 2013). Despite its virtues, some of the assumptions underlying CBA are criticized by notable philosophers, economists, and psychologists alike (e.g., Ackerman & Heinzerling, 2004; Kelman, 1981; Nyborg, 2014; Sagoff, 1988; Thaler, 1999; Tversky and Kahneman, 1981). As it is out of the scope of this chapter to review this literature, we limit ourselves to two critiques that are relevant for the evaluation of PPP investments in port areas.

The first criticism is targeted toward the postulation in CBA that only persons within a country's national boundaries are counted in the analysis. This postulation is contested by cosmopolitans, who argue that governments should treat foreigners and residents in the same way in a CBA because it is unethical to discriminatorily allocate resources between domestic and foreign persons (Singer, 1972). Cosmopolitans, for instance, emphasize that the welfare effects of a government policy do not magically cease to exist at political borders (Rowell & Wexler, 2014). This debate is especially relevant for port investments, which generally have an international character. This particularly holds for cross-border projects, such as the deepening of the Scheldt's Waterway to Antwerp and the proposed Freight Rail projects between Antwerp and Germany (the *IJzeren Rijn*) and between Antwerp and Rotterdam (the *Robellijn*).

The second line of critique focuses on the postulation in CBA that a project's societal value is independent on how the project is financed (Harberger, 1978). This postulation is also called "complete fungibility": it does not matter whether governmental projects are financed with private or public Euros, because both types of budgets cannot have a different purpose. A crucial issue is that "complete fungibility" does not fit with what is observed in reality (e.g., Thaler, 1999; Tversky & Kahneman, 1981). Thaler (1999), for instance, shows that individuals explicitly and/or implicitly group their expenses into categories ("mental accounts"). Income and assets are distributed across the categories to form "sub-budgets" within the overall budget, and Euros contained within a given budget can have a specific goal or purpose. As such, they are at best imperfect substitutes for Euros from other budgets, even for the same individual. From this point of view, a more defensible notion is to assume that individuals view their own money and government funds as being from two separate budgets. The implication of the assumption that individuals believe that private Euros and public Euros can have different purposes is that the extent to which a particular port investment is financed from public Euros or private Euros impacts the way the project should be evaluated in a CBA. That is, when the project is fully funded from public resources, its welfare effects should be inferred from individuals' preferences regarding the use of public Euros, which could be elicited in a context in which individuals make choices when faced with effects accruing from alternative allocations of government budget (e.g., Goel et al., 2016; Mouter et al., 2017): the so-called "willingness to allocate perspective." In the case the project is both funded by private and public Euros, the private part should be evaluated using the conventional willingness to pay approach, whereas the public share is assessed using a willingness to allocate approach.

Public Sector Comparator

Following these critiques, other methods have been proposed to evaluate transport infrastructure investments. For instance, the European Union used the BENEFIT approach, and at the national level, governments use tools such as the Public Sector Comparator (PSC). The PSC is the benchmark costs of providing the service specified by the public procurer with traditional procurement, which is then compared with the costs of providing the service through a PPP (see, e.g., Grimsey & Lewis, 2004, 2005; Boardman & Hellowell, 2017; World Bank Institute, 2013). The PSC basically answers the question whether or not procurement of infrastructure and related services is good value for money (VfM) compared to traditional or standard public sector procurement (Yescombe, 2007). In the Netherlands, the standard procurement option today is the design-and-construct (D&C) contract (Lenferink et al., 2013), and DBFM (design-build-finance-maintain) is the default PPP option

(Rijksoverheid, 2018). Although the private contractor is integrally responsible for infrastructure construction and design in both D&C and DBFM (Culp, 2011), the latter is considered a type of PPP, whereas the former is not (Yescombe, 2007; e.g., Rijksoverheid, 2018). The reason is that private financing is considered an essential element in PPPs, which is present in DBFM but not in D&C. Because governments have clear financing cost advantages over private consortia (Leruth, 2012; Moore et al., 2017), in the Netherlands, DBFM is normally only considered, using the PSC, for projects over €60 million (van Financiën, 2013). Based on existing evidence, the Dutch Ministry of Finance estimates that DBFM(O) projects achieve cost advantages—in terms of VfM—ranging from 10 to 15% (van Financiën, 2016). A shortcoming of this focus on prospective outcomes, using tools such as the PSC, is, however, that it is unclear whether the outcomes actually materialize; they do not account for the actual value achieved during and after the project's lifecycles (Boers et al., 2013). For instance, low bids on contracts may evaporate due to contract claims during project construction (Mohamed et al., 2011), and unforeseen events may impact the project scope and lead to implementation difficulties that impact project costs (e.g., Verweij et al., 2017). As a result of consequent contract changes, the cost advantage of PPPs over regular infrastructure procurement may potentially even be nullified (cf. Van Elst & Van Montfort, 2018). Therefore, scholars have recently called for more research into the actual outcomes of PPPs (i.e., outcomes occurring after contracts were signed) compared to traditionally procured projects (Verweij, 2018).

BENEFIT

The BENEFIT[1] project analyzes funding schemes within an interrelated system. Funding schemes are deemed to be successful based on a number of dimensions:

- The business model that generates the funding scheme, as well as their stakeholders and policy contexts
- The implementation context, including contextual changes over time and space, among which changes in overarching policy
- Transport mode context, which reflects the availability and reliability of infrastructure.
- The financing scheme, which shows the nature and sources of financing used to make the investment
- The governance model and more in particular the contracting arrangements

The above are key elements in transport infrastructure provision, operation, and maintenance, as illustrated in Figs. 1 and 4.

[1] BENEFIT: business models for enhancing funding and enabling financing for infrastructure in transport, www.benefit4transport.eu

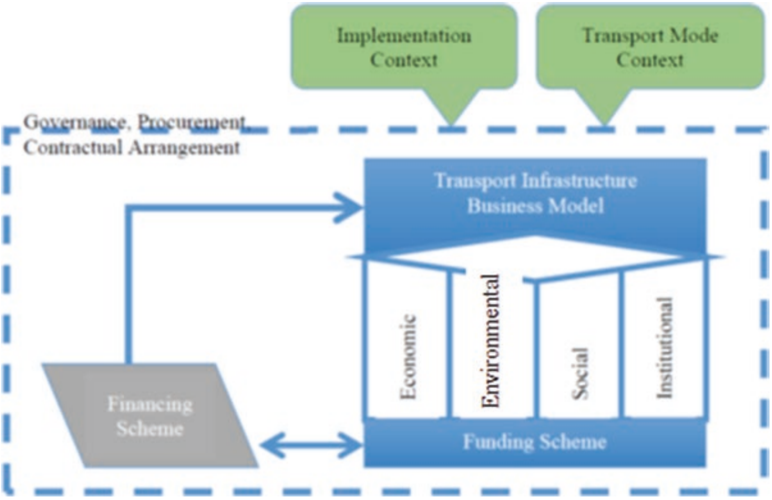

Fig. 4 BENEFIT key dimensions in transport infrastructure investment. *Source:* Roumboutsos et al. (2014)

By defining indicators for each of the abovementioned dimensions, an input-output model is created, whereby success can be linked to a combination of indicator values occurring. Such combinations are called typologies. Best matches between typologies and success allow for the development of a Decision Matching Framework. This framework enables all concerned actors to analyze the potential and thereby make decisions that lead to the most desirable outcome. The BENEFIT Decision Matching Framework makes use of following indicators as listed in Table 1. The indicators are operationalized according to the calculation methods identified in the Appendix A. Note that the FEI and InI indicators are composed of values from publicly available sources, while the other indicators are based on expert judgments for the values of the composing subdimensions. Expert judgments are taken from a variety of concerned stakeholders for the considered projects, each time covering the different points of view (project principal, user, technology provider, etc.), so as to avoid bias in the answers.

Key findings can be identified with respect to the influence that indicators have on the four specific outcomes considered within the BENEFIT Matching Framework, i.e., cost to completion, time to completion, actual versus forecast traffic, and actual versus forecast revenues. The approach to do so can be summarized as matching the scorings to the abovementioned matching framework indicators with success scores attached to the four outcomes. The BENEFIT approach will also be used in this chapter to compare the different projects with each other.

Table 1 BENEFIT Matching Framework indicators

Indicator	Subdimension
Financial-economic (FEI)	Competitiveness Economic/financial key figures PPP support
Institutional (InI)	Political (political capacity, support, and policies) Regulatory (legal and regulatory framework) Administrative (public sector capacity)
Governance (GI)	Efficiency/effectiveness of governance Contractual flexibility
Cost-saving (CSI)	Capability to construct Capability to innovate Capability to operate
Revenue Support (RSI)	Share of non-transport activities Capability to manage revenue risk Level of optimal other revenue risk allocation
Remuneration attractiveness (RAI)	Cost recovery Risk of income Operational performance
Revenue robustness (RRI)	Cost coverage Risk of revenues Optimal operational performance
Market efficiency and acceptability (MEAI)	Market and environmental efficiency Public acceptability of funding scheme
Financing scheme (FSI)	Project gearing ratio Sources of finance
Reliability/availability (IRA)	Investment Users Market strength/competitiveness

The Three Infrastructure Projects Compared and Evaluated

Following the BENEFIT approach, the three projects Liefkenshoektunnel, Second Maasvlakte, and the Kieldrecht Lock are compared and analyzed, after the completion of all projects. Input data for the analysis are shown in Table 2. The figures in this table are obtained by applying the calculation approach from the Appendix A. There, for each dimension and subdimension, the possible values are shown. Expert judgments, including different types of concerned actors and stakeholders and reports for each case, are used to score each subdimension. Experts include both contractors involved, as well as financiers, public authorities, and port authorities. Scores were for each subdimension averaged over the various stakeholders.

First of all, Table 2 shows that the MV2 dominates the Liefkenshoektunnel on all indicators, the “Governance” and “CSI” indicators being the exceptions. Second, Table 2 shows that the three case studies score in a quite similar way on various indicators, examples being “Financial-economic” (FEI), “Institutional” (InI), “Governance” (GI), and “Reliability/availability” (IRA). This can be explained by the fact that all projects are implemented in Belgium and the Netherlands, which

Table 2 BENEFIT approach applied on the three projects

Indicator	Subdimension	LHRT	MV2	KDL
Financial-economic (FEI)	Competitiveness Economic/financial key figures PPP support	0.691	0.785	0.641
Institutional (InI)	Political (political capacity, support, and policies) Regulatory (legal and regulatory framework) Administrative (public sector capacity)	0.74	0.94	0.78
Governance (GI)	Efficiency/effectiveness of governance Contractual flexibility	0.688	0.636	0.625
Cost-saving (CSI)	Capability to construct Capability to innovate Capability to operate	0.639	0.617	0.367
Revenue support (RSI)	Share of non-transport activities Capability to manage revenue risk Level of optimal other revenue risk allocation	0.133	0.691	0.245
Remuneration attractiveness (RAI)	Cost recovery Risk of income Operational performance	0.667	1.0	0.667
Revenue robustness (RRI)	Cost coverage Risk of revenues Market and environmental efficiency Public acceptability of funding scheme	0.741	1.5	0.750
Market efficiency and acceptability (MAEI)		0.444	0.65	0.833
Financing scheme (FSI)	Project gearing ratio Sources of finance	0.458	1.0	0.655
Reliability/availability (IRA)	Investment Users Market strength/competitiveness	1	1	1
On/over cost		Over	On	Over
On/over time		Over	On	Over
On/below traffic		Below	To be seen	On
On/below revenue		Below	To be seen	On

Sources: own calculation

perform relatively similarly in terms of financial-economic conditions (FEI), and both countries are characterized by a relatively stable political environment as well as by a properly functioning rule of law (InI). High values for the latter two indicators are important for achieving high outcome scores on cost, time, and traffic. LHRT and KDL went over time, with LHRT, for instance, featuring 2.5 years of delay in the actual contract signing, and KDL even a delay of 15 years between initial plans and contract signing. As these indicators are based on internationally accepted country performances and as the differences between Belgium and the Netherlands are not too large, these are not the indicators where the differences between infrastructure projects will be found. Quite interestingly, all three case studies improved the reliability and availability of the infrastructure fully in line with expectations (IRA). Third, Table 2 shows that the cases perform differently on some other indicators such as :Revenue support" (RSI), "Revenue robustness" (RRI), and "Financing Scheme" (FSI). Particularly the revenue support drastically differs between the MV2, which performs quite well on this indicator, and the Liefkenshoektunnel, which performs very poorly, especially as reliability in the initial years was lower than expected, therefore leading to somewhat lower usage and compensations to be paid. The latter is rather strange for port-related projects, since both ports have a nodal function, at the intersection of many modes of transport, which usually reflects in a high RSI. Furthermore, also the larger revenue-generating possibility for the MV2 (via rents and port dues) influences these indicators for the MV2 project in a positive way. Fourth, for all three outcomes, the observation from Roumboutsos et al. (2014) has confirmed that the CSI for port projects is typically low: this has to do with the fact that, also here, the projects are mostly handled by a PPP consortium primarily for its operating skills, and less for its construction skills. That explains also why projects with a higher CSI typically have a somewhat better cost, time, traffic, and revenue performance. Fifth and finally, a high remuneration attractiveness (RAI) contributes to a better revenue outcome score. Only LHRT explicitly does not seem to confirm this picture, probably due to the fact that it concerns a port hinterland transport link rather than a port terminal project.

Conclusions and Discussion

In this chapter, we presented the results of the analysis of three cases of infrastructure investments with the BENEFIT approach. The BENEFIT framework is designed to overcome some of the critiques raised against the cost-benefit analysis (CBA), which is nowadays still considered the gold standard for supporting public decision-making. In essence, BENEFIT evaluates infrastructure investments from different angles and by using different methods, which enhances the documentation and quality of investment decisions. The central research question was as follows: which success and failure factors can be identified from PPP experiences in the port areas of Antwerp and Rotterdam, and how can this inform effective PPP design? From the comparison and evaluation of the three cases, several conclusions arise.

Firstly, the MV2 project clearly outperformed the Liefkenshoektunnel and Kieldrecht Lock projects on the indicators RSI, RRI, and FSI. The analysis shows that the Second Maasvlakte project has a better revenue support, revenue robustness, and financing scheme. This result indicates that infrastructure projects with larger revenue-generating possibilities (such as the MV2 through rents and seaport dues) will influence the performance of this type of projects in a positive way, compared to projects with less revenue possibilities such as roads and locks. Secondly, differences in country performance on internationally accepted indicators can also influence differences in infrastructure investments between countries. Directly with the project, these indicators do not distinguish among the projects too much (such as FEI and Inl), but indirectly, they influence the performance of the respective infrastructure projects. In this chapter, we raise attention to the issue that while the CBA is still the most widely used approach, it also received criticism increasing the call for alternative assessment approaches for evaluating the success of PPP projects. One option is the BENEFIT approach, which we applied in this chapter. Admittedly, though the evaluation methods are designed for different purposes. Moreover, there are also limitations to the BENEFIT framework. For one thing, while BENEFIT provides a transparent framework through quantification for the comparison of PPP transport projects, it remains descriptive for seaports, as opposed to other modes. For seaports, no conclusive trends with respect to influencing indicators could be found. The latter is a requirement for being able to develop and apply the quantitative transport infrastructure rating instrument, which within BENEFIT was developed for most other modes. Therefore, findings of this paper can therefore not be generalized to just any port PPP case, let alone making a comparison between port PPP projects and publicly funded projects. However, the approach and method for sure can. The figures can be transferred to other cases, the setting of which is as much similar as possible only. Other cases can of course apply the same approach and calculate the outcomes for their specific setting. To be able to explain differences between PPP projects more fully, it will be interesting to combine the application of the BENEFIT framework with analytical methods such as qualitative comparative analysis (QCA) (see Gerrits and Verweij, 2018). Therefore, the combined and integrated application and comparison of different methods to the same infrastructure project might also help to arrive at infrastructure investment project approvals that are of high-quality, well-documented, and substantiated. The main point is also that this will allow us to learn better from past projects for future projects. Preferably, this should in future work also be applied to a wider set of cases. The same extended approach could also be applied to compare between PPP projects and publicly funded projects.

Appendix

This Appendix operationalizes the various BENEFIT indicators mentioned in "Evaluation Frameworks: CBA, PSC, and BENEFIT" section of the main text, so as to be used in "The Three Infrastructure Projects Compared and Evaluated" section for the concrete case calculations.

FEI

FEI1	The (growth) competitiveness index developed by the World Economic Forum	A score between 1 (weak) and 7 (strong), rescaled to between 0/1
FEI2	Inflation (consumer prices), general government final consumption expenditure, GDP per capita growth and unemployment rate.	Composed by two governance indicators of the World Bank—rule of law and regulatory quality—combined with the aggregated OECD indicators of regulation in energy, transport, and communications (ETCR) on the regulatory restrictiveness (inverse of level of liberalization) of markets, each scaled between 0 and 1 and weighted
FEI3	S&P global equity prices and domestic credit to private sector	publicly available figures, rescaled to between 0 and 1
FEI4	PPP governmental support index as developed	Government effectiveness indicator by the World Bank, each scaled between 0 and 1 and weighted
FEI		(FEI1 + FEI2 + FEI3 + FEI4)/4

INI

INI1	"Political" subdimension "political capacity, support, and policies"	Composed of three main governance indicators of the World Bank: political stability and absence of violence, control of corruption, and voice and accountability, each scaled between 0 and 1 and weighted
INI2	"Regulatory" subdimension "legal and regulatory framework"	Composed by two governance indicators of the World Bank—rule of law and regulatory quality—combined with the aggregated OECD indicators of regulation in energy, transport, and communications (ETCR) on the regulatory restrictiveness (inverse of level of liberalization) of markets, each scaled between 0 and 1 and weighted
INI3	"Administrative" subdimension "public sector capacity"	Government effectiveness indicator by the World Bank, each scaled between 0 and 1 and weighted
FEI		(INI1 + INI2 + INI3)/3

GI

G1	The client selected only one service provider [bidder] to participate in the pricing stage	0 = more than one bidder selected in pricing stage + no collective project cost estimation 0.5 = only one bidder selected in pricing stage/collective project cost estimation 1 = only one bidder selected in pricing stage + collective project cost estimation
G2	The client and the key service providers [bidders] collectively estimated the expected project cost	

G3	Encouragement of competition between bidders	0/1
G4	Integration of design and construction	0/1
G5	The key service providers [contractor] to pay a penalty if completion dates were not met	0 = no penalty + no cost risk 0.5 = penalty/cost risk 1 = penalty + cost risk
G6	The key service providers [contractor] solely carried the risk of rising costs	
G7	The client and key service providers [contractor] [to share] shared equal proportions of profit due to cost underruns	0/1
G8	Bonding requirements	0/1
G9	All exploitation, commercial/revenue and financial risks are shared	0/1
G10	Clauses enable both updating of service and price changes	0 = no clause present 1 = one of or both clauses present
G11	Clauses indicate that client has an option to terminate the agreement without cause	0/1
GI		(G1 + G2 + G3 + G4 + G5 + G6 + G7 + G8 + G9 + G10 + G11)/11

CSI

x_1	Level of civil works	%
x_2	Capability to construct	%
x_3	Optimal construction risk allocation	%
x_4	Adoption of innovation	0/1
x_5	Capability to manage the application of innovation	1 = ex ante or ex post if successful 0 = ex post if unsuccessful
x_6	Share of other transport infrastructure investment	%

x_7	Life cycle planning	0/1
x_8	Capability to operate	%
x_9	Optimal operational risk allocation	%
CSI		$x_2x_3 - (x_1 - x_1x_2x_3) + x_4x_5 + x_7x_8x_9$

RSI

x_{10}	Share of greenfield	%
x_{11}	Coopetition (for greenfield)	%
x_{12}	Capability to manage traffic demand (for greenfield)	%
x_{13}	Optimal traffic demand risk allocation (for greenfield)	%
x_{14}	Level of satisfaction (for greenfield)	1 = more than 50% very satisfied 0.5 = more than 50% satisfied 0 = less than 50% satisfied
x_{15}	Share of brownfield	%
x_{16}	Coopetition (for brownfield)	%
x_{17}	Capability to manage traffic demand (for brownfield)	%
x_{18}	Optimal traffic demand risk allocation (for brownfield)	%
x_{19}	Level of satisfaction (for brownfield)	1 = more than 50% very satisfied 0.5 = more than 50% satisfied 0 = less than 50% satisfied
x_{20}	Share of non-transport activities	%
x_{21}	Capability to manage the non-transport revenue risk	0 / 1
x_{22}	Optimal other revenue risk allocation	%
x_{23}	Other economic impacts	Positive impacts: 1 Negative impacts: −1 No influence: 0
x_{24}	Other environmental impacts	Positive impacts: 1 Negative impacts: −1 No influence: 0
x_{23}	Social impacts	Positive impacts: 1 Negative impacts: −1 No influence: 0
x_{24}	Institutional impacts	Positive impacts: 1 Negative impacts: −1 No influence: 0
RSI		$1 + x_{10}x_{11}x_{12}x_{13}x_{14} + x_{15}x_{16}x_{17}x_{18}x_{19} + x_6x_{11}x_{12}x_{13}x_{14} + x_{20}x_{21}x_{22} + x_{23} + x_{24} + x_{25} + x_{26}$

RAI

RAI1	Cost recovery	%
RAI2	*a: Share of income stream i on total revenues*	% share of income stream i on total revenues
	b: Risk of income source i	Usage payment: 3 Availability payment: 2 Quality performance payments: 2 Subventions: 1
	Risk of income	s: Σ(*a.b*)
RAI3	*si: score of income (or penalty) stream i on incentives*	1 (inadequate incentive) to 4 (adequate incentive)
	wi: % of income stream i on total income	%
	Optimal operational performance	s: Σ(*wi.si*)
RAI		(RAI1 + RAI2 + RAI3)/3

RRI

RRI1	Cost coverage	% w: 2
RRI2	*a: Share of revenue stream i on total revenues*	%
	b: Risk of revenue source i	scale: 1 (low risk) to 4 (high risk)
	Risk of revenues	s: Σ(*a.b*)
RRI		(2RRI1 + RRI2)/2

MEAI

MEAI1	*smc1: Adherence of infrastructure use pricing scheme to (social) marginal costs of infrastructure use*	1–4 (1, not related; 4, fully related)
	smc2: Application of consistent marginal cost pricing scheme in concurrent infrastructure	0/1
	Market and environmental efficiency	s: smc1 (smc2 cond.)
MEAI2	*pa1: Direct benefits of project to funding agent(s)*	1–4 (1, no benefits to funding agent(s); 4, full alignment of benefits to funding agent)
	pa2: Perception that pricing revenue is applied toward a desired objective	1–4 (1, application of revenues not transparent; 4, application of revenue transparent and towards a desired objective)
	Public acceptability of funding scheme	s: pa1 + 0.5*pa2
MEAI		(MEAI1 + MEAI2)/2

FSI

D	Debt indicator	Debt A. Investors (debt) with a high aversion against risk taking: the general public (tradable bonds), other institutional investors (e.g., pension funds, insurance companies, other funds), non-leading banks: 4 Debt B. Lead banks: 3 Debt C. International Financial public Institutions IFIs (e.g., EIB): 1, 5 Debt D. Government: 1
E	Equity indicator	Equity A. Investors (equity) with a high aversion against risk taking: the general public (tradable shares), commercial Banks: 4 Equity B. Infrastructure funds and private equity funds, individual affiliated investors (e.g., contractors, operators and other project sponsors): 3 Equity C. Government
FSI		= 0.5 * Ieq * (1 − d) + Idebt * d, d = share of debt

IRA

R	Level of reliability	Reliability was improved fully in line with expectations or even more: 1 Reliability was improved only partially in line with expectations: 0.50 Reliability was not improved or only marginally: 0.0
A	Level of availability	Availability was improved fully in line with expectations or even more: 1 Availability was improved only partially in line with expectations: 0.50 Availability was not improved or only marginally: 0.0
IRA		(1 + IR) * (1 + IA)/4

References

Ackerman, F., & Heinzerling, L. (2004). *Priceless: On knowing the price of everything and the value of noting*. The New Press.

Andersson, H., Hultkrantz, L., Lindberg, G., & Nilsson, J. E. (2018). Economic analysis for investment priorities in Sweden's transport sector. *Journal of Benefit Cost Analysis, 9*(1), 120–146.

Annema, J. A., Frenken, K., Koopmans, C. C., & Kroesen, M. (2017). Relating cost-benefit analysis results with transport project decisions in the Netherlands. *Letters in Spatial and Resource Sciences, 10*(1), 109–127.

Bamelis, F. (2015). Interview: Financing and capital structure of the Liefkenshoek Rail Connection project. *Infrabel*.

Boadway, R. (2006). Principles of cost-benefit analysis. *Public Policy Review, 2*(1), 1–42.

Boardman, A. E., & Hellowell, M. (2017). A comparative analysis and evaluation of specialist PPP units' methodologies for conducting value for money appraisals. *Journal of Comparative Policy Analysis: Research and Practice, 19*, 191–206.

Boers, I., Hoek, F., Van Montfort, C., & Wieles, J. (2013). Public-private partnerships: International audit findings. In P. De Vries & E. B. Yehoue (Eds.), *The Routledge companion to public-private partnerships* (pp. 451–478). Routledge.

Culp, G. (2011). Alternative project delivery methods for water and wastewater projects: Do they save time and money? *Leadership and Management in Engineering, 11*(3), 231–240.

Eliasson, J., & Lundberg, M. (2012). Do cost-benefit analyses influence transport investment decisions? Experiences from the Swedish transport investment plan 2010–2021. *Transport Reviews, 32*(1), 29–48.

European PPP Expertise Centre. (2015). *PPP motivations and challenges for the public sector: Why (not) and how*. European Investment Bank.

Gerrits, L. M., & Verweij, S. (2018). *The evaluation of complex infrastructure projects: A guide to qualitative comparative analysis*. Edward Elgar.

Goel A., Krishnaswamy A., Sakshuwong S., & Aitamurto T. (2016). A knapsack voting for participatory budgeting. Retrieved from https://pdfs.semanticscholar.org/1bcf/e28a95ab-d46c7b7127112624f4fd72f803aa.pdf

Grimsey, D., & Lewis, M. K. (2004). *Public private partnerships: The worldwide revolution in infrastructure provision and project finance*. Edward Elgar.

Grimsey, D., & Lewis, M. K. (2005). Are public private partnerships value for money? Evaluating alternative approaches and comparing academic and practitioner views. *Accounting Forum, 29*(4), 345–378.

Hahn, R. W., & Tetlock, P. C. (2008). Has economic analysis improved regulatory decisions? *Journal of Economic Perspectives, 22*(1), 67–84.

Harberger, A. (1978). On the use of distributional weights in social cost-benefit analysis. *Journal of Public Economy, 86*(2), S87–S120.

Kelman, S. (1981). Cost-benefit analysis: An ethical critique. In T. Donaldson, P. H. Werhane, & M. Cording (Eds.), *Ethical issues in business: A philosophical approach* (pp. 559–564). Pearson.

Lenferink, S., Tillema, T., & Arts, J. (2013). Towards sustainable infrastructure development through integrated contracts: Experiences with inclusiveness in Dutch infrastructure projects. *International Journal of Project Management, 31*(4), 615–627.

Leruth, L. E. (2012). Public-private cooperation in infrastructure development: A principal-agent story of contingent liabilities, fiscal risks, and other (in)pleasant surprises. *Networks and Spatial Economics, 12*(2), 223–237.

Mackie, P. J., Worsley, T., & Eliasson, J. (2014). Transport appraisal revisited. *Research in Transportation Economics, 47*, 3–18.

Ministerie van Financiën. (2013). *Handleiding publiek-private comparator*. Ministerie van Financiën.

Ministerie van Financiën. (2016). *Voortgangsrapportage DBFM(O) 2016/2017*. Ministerie van Financiën.

Mohamed, K. A., Khoury, S. S., & Hafez, S. M. (2011). Contractor's decision for bid profit reduction within opportunistic bidding behavior of claims recovery. *International Journal of Project Management, 29*(1), 93–107.

Moore, M. A., Boardman, A. E., & Vining, A. R. (2017). Analyzing risk in PPP provision of utility services: A social welfare perspective. *Utilities Policy, 48*(C), 210–218.

Mouter, N., Annema, J. A., & Van Wee, B. (2013). Attitudes towards the role of cost-benefit analysis in the decision-making process for spatial-infrastructure projects: A Dutch case study. *Transportation Research Part A, 58*, 1–18.

Mouter, N., Van Cranenburgh, S., & Van Wee, B. (2017). Do individuals have different preferences as consumer and citizen? The trade-off between travel time and safety. *Transportation Research Part A, 106*, 333–349.

Nyborg, K. (2014). Project evaluation with democratic decision-making: What does cost-benefit analysis really measure? *Ecological Economics, 105*, 124–131.

Petit, F. (2015). Infrabel rondt de financiële en contractuele closing van de Liefkenshoekspoorverbinding af (PPS). *Infrabel*. Retrieved online from http://www2.vlaanderen.be/pps/documenten/Infrabel_persbericht_liefkenshoekspoorverbinding%27_051108.pdf.

Vlaamse Regering (2012). Verslag van de Vlaamse regering van alternatieve financiering van Vlaamse overheidsinvesteringen van 9 November 2012, Parl.St. Vl.Parl., 2012-13, 1.

Rijksoverheid. (2018). *Publiek-private samenwerking (PPS) bij het Rijk*. Retrieved online from https://www.rijksoverheid.nl/onderwerpen/publiek-private-samenwerking-pps-bij-het-rijk.

Romijn, G., & Renes, G. (2013). *Dutch general CBA guideline*. Centraal Planbureau & Planbureau voor de Leefomgeving.

Roumboutsos, A., Sfakianakis, E., Konstantinipoulos, M., Moraiti, P., Karousos, I., Pantelias, A., Edkins, A., Leviakangas, P., Vanelslander, T., Moshouli, E., Verhoest, K., & Murwantara, R. (2014). *The decision matching framework policy guiding tool*. Retrieved online from http://www.benefit4transport.eu/index.php/reports.

Rowell, A., & Wexler, L. (2014). Valuing foreign lives. *Georgia Law Review, 499*, 524–539.

Sagoff, M. (1988). *The economy of the Earth: Philosophy, law, and the environment*. Cambridge University Press.

Singer, P. (1972). Famine, affluence, and morality. *Philosophy and Public Affairs, 1*(3), 229–243.

Thaler, R. (1999). Mental accounting matters. *Journal of Behavioural Decision Making, 12*, 183–206.

TUC RAIL. (2015). Liefkenshoek Railway Link. Retrieved online from http://www.tucrail.be/EN/projects/NationalProjects/Liefkenshoek/Pages/Liefkenshoek.aspx.

Tversky, A., & Kahneman, D. (1981). The framing of decisions and the psychology of choice. *Science, 211*, 453–458.

Van Elst, D., & Van Montfort, C. (2018). Publiek-private samenwerking: Internationale en nationale studies van de Algemene Rekenkamer. In M. Sanders (Ed.), *Publiek-private samenwerking: Kunst van het evenwicht* (pp. 169–185). Boom Bestuurskunde.

Van Olmen, G. (2015). Interview: Financing and capital structure of the Liefkenshoek Rail Connection project. *Infrabel*.

Van Wee, B. (2012). How suitable is CBA for the ex-ante evaluation of transport projects and policies? A discussion from the perspective of ethics. *Transport Policy, 19*(1), 1–7.

Verweij, S. (2018). Meerwaarde door PPS: Welke meerwaarde? *Agora, 34*(3), 34–37.

Verweij, S., Teisman, G. R., & Gerrits, L. M. (2017). Implementing public-private partnerships: How management responses to events produce (un)satisfactory outcomes. *Public Works Management & Policy, 22*(2), 119–139.

Wiegmans, B. W., Ubbels, B., Rietveld, P., & Nijkamp, P. (2002). Investments in container terminals: Public private partnerships in Europe. *International Journal for Maritime Management, 4*(1), 1–20.

World Bank Institute. (2013). *Value-for-money analysis-practices and challenges: How governments choose when to use PPP to deliver public infrastructure and services*. World Bank Institute.

Yescombe, E. R. (2007). *Public-private partnerships: Principles of policy and finance*. Butterworth-Heinemann.